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Validation of Crew Coordination Training and Evaluation Methods for Army Aviation

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13. ABSTRACT (Maximum 200 words):

At the request of the U.S. Army Aviation Center (USAAVNC), the Army Research Institute Rotary-Wing Aviation Research Unit (ARIRWARU) developed field exportable training and evaluation materials for aircrew coordination. A testbed of the materials was implemented with the cooperation of the 101st Aviation Brigade. Sixteen aircrews participated. Using a UH-60 flight simulator, aircrews were evaluated while executing a comprehensive tactical mission. Evaluation data were collected before and after aircrew coordination training was provided. Evaluation measures included attitude, behavior, task performance, and mission performance. Results showed that (1) the training had positive effects on all of the measures, and (2) the measures are sensitive to changes in performance. The impact on safety of flight was also assessed. The report concludes with recommendations and suggested areas for future research.

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VALIDATION OF CREW COORDINATION TRAINING AND EVALUATION METHODS FOR ARMY AVIATION

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VALIDATION OF CREW COORDINATION TRAINING AND EVALUATION METHODS FOR ARMY AVIATION

Introduction

Dynamics Research Corporation (DRC), under contract to the Army Research Institute Rotary-Wing Aviation Research Unit (ARIRWARU), developed and evaluated an exportable Army Crew Coordination training and evaluation package. The development of the training and evaluation systems is discussed in companion volumes delivered to ARIRWARU (Grubb, Simon, Leedom, & Zeller, in preparation; and Pawlik, Simon, Grubb, & Zeller, in preparation). Two products, a Field Exportable Evaluation Package (Grubb, Simon, & Zeller, 1992) and a Field Exportable Training Package (Pawlik, Simon, Grubb, & Zeller, 1992), were also delivered under the current contract. The U.S. Army Aviation Center (USAAVNC) sponsored a crew coordination validation testbed of DRC's materials and methods at Fort Campbell, KY from 3 August - 2 September 1992. This report focuses on the results of using the evaluation measures (Grubb et al., in preparation) during that testbed. See Figure 1, crew coordination evaluation and training products.

Background

For the past three years, ARIRWARU has undertaken a comprehensive research and development effort on crew coordination training and evaluation in Army aviation. A proof-of-concept training and evaluation system was first tested with two assault helicopter battalions (UH-60) at Fort Campbell during the Spring of 1990 (Simon, 1990, 1991). At about the same time, the U.S. Army Safety Center (USASC) identified crew coordination failures as a major problem. During the period FY 84-89, crew coordination failures identified by the USASC directly contributed to the loss of 147 lives and $292 million in aviation accident costs. These accidents were caused by the failure of experienced and qualified aviators to coordinate their decisions and actions in the cockpit. In 1990, the Deputy Chief of Staff for Operations and Plans directed the USAAVNC to focus its aviation training and evaluation on crew performance. In 1991, ARIRWARU assisted the USAAVNC in the rewriting of TC 1-210, *Aircrew Training Program Commander's Guide to Individual and Crew Training*, and various Aircrew Training Manuals (ATM) for each aircraft type. Through these efforts, the Army was able to define more precisely the need for crew coordination and the means for achieving it. Much of this unprogrammed assistance was based on ARIRWARU's research on crew error patterns.

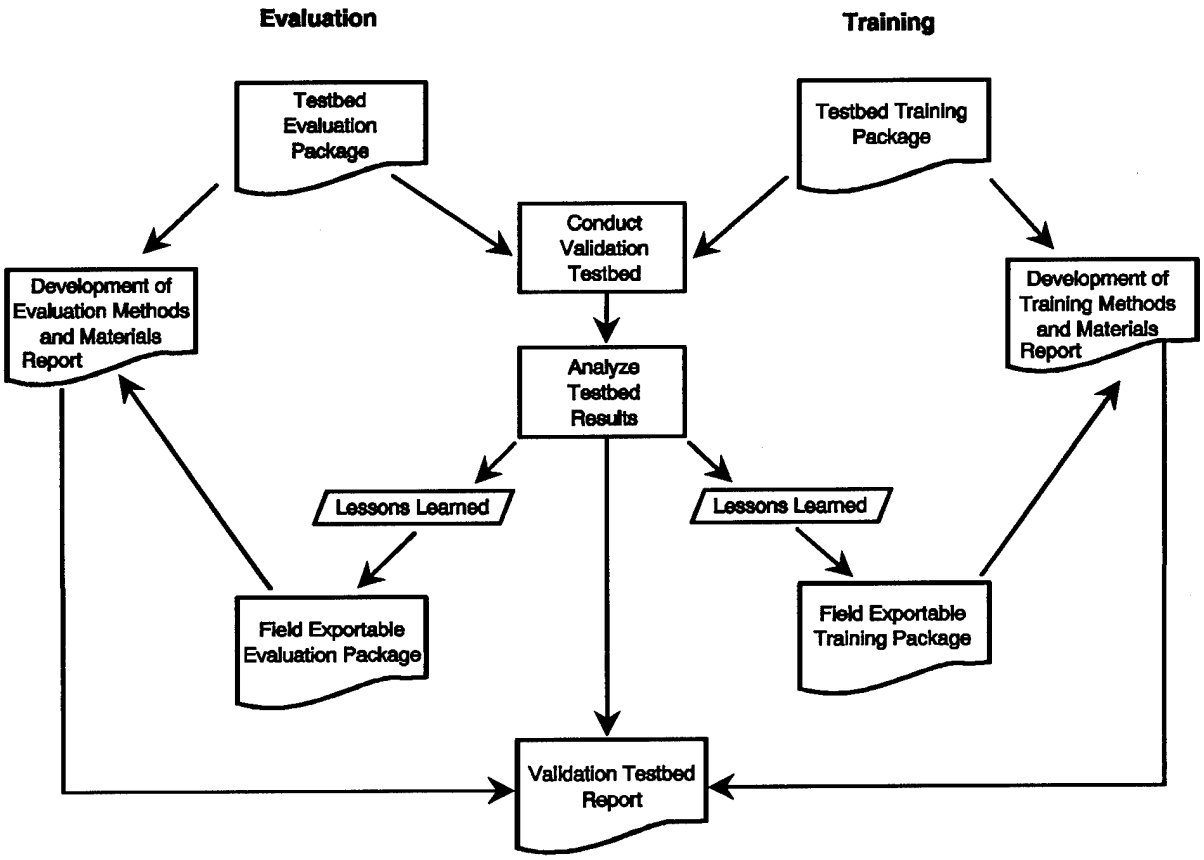

Figure 1. Summary and relationships of crew coordination evaluation and training products.

By 1992, it was clear that additional training research would be needed to determine how best to transition existing aircrews to the new training standards. As a result, the USAAVNC sponsored ARIRWARU to develop and validate a new exportable training concept for Army aviators. While some training materials were available from commercial aviation and other services, their contents were not suited to Army aviation. Additional challenges associated with this training research included (a) identification of specific human error patterns that were correctable through training, (b) development of observable performance standards, and (c) identification of crew member actions required for each specific flight task.

Beginning in February 1992, DRC worked closely with the USAAVNC Working Group to review existing materials and develop a training and evaluation system to accompany the newly revised ATMs. The Working Group guided DRC in defining key concepts for

the system, such as the Crew Coordination Objectives and the related Basic Qualities, that crews should master during training and demonstrate during evaluations. After drafting training and evaluation materials and methods for a crew coordination validation testbed effort, DRC worked with the 101st Aviation Brigade (Air Assault) at Fort Campbell to implement the validation testbed. The objectives of the validation testbed were to:

1. Demonstrate and validate the new field exportable program for training and evaluating crew coordination skills in Army aviators.

2. Assess the potential for this type of training to increase military effectiveness and enhance aviation safety.

Methodology and Sample Description

Methodology

Drafts of the Field Exportable Training Package (Pawlik et al., 1992) and the Field Exportable Evaluation Package (Grubb et al., 1992), and the implementation methods associated with them, were tested at Fort Campbell. These packages are briefly summarized below:

Aircrew Coordination Exportable Training Package (Pawlik et al., 1992) - This training package was designed for three audiences: trainers, instructors, and aircrews. The USAAVNC-certified crew coordination trainers teach unit instructors, who then train unit aircrews (rated and nonrated crew members). Training for the unit instructors in the testbed version of the aircrew coordination course consisted of 26 hours of instruction broken into four phases covering methods of instruction, the Aircrew Coordination Student Course, an evaluation workshop, and scenario familiarization. Training for unit aircrew testbed participants consisted of 18 classroom hours and two 5-hour training missions in the visual flight simulator facility. The 5-hour simulator sessions included premission planning, simulator flight, postmission after-action review conducted by the aircrews, and an instructor debrief of the entire process.

The goal of the initial training was to bring the participating aircrews to a *satisfactory* level of performance of crew coordination skills and behaviors. It was expected that performance above the satisfactory level would take more training time than was available during the testbed.

Crew Coordination Exportable Evaluation Package for Army Aviation (Grubb et al., 1992) - This field exportable evaluation package was designed for unit instructors (instructor pilots (IPs) and unit trainers (UTs)) to complement and evaluate the

training provided to unit aircrews. Several measures were designed specifically for use in the validation testbed and are not intended to be fielded. The primary question asked through the use of the evaluation measures was whether the aircrews showed improvement between the pre- and post-training evaluations. The secondary questions were whether the IPs easily understood and used the measures, and whether the measures produced reliable evaluation data. The measures and the results of their use in the testbed are described in their respective sections within this report. Following is the list of measures composing the measurement suite used in the testbed. Measures that are part of the exportable evaluation package are italicized.

Attitude -- The "Army Aviation Crew Member Questionnaire"

Behavior -- Basic Qualities associated with crew coordination captured through use of the Aircrew Coordination Evaluation (ACE) Checklist

Behavior and Performance -- A grade slip based on UH-60 ATM Tasks revised to incorporate aircrew coordination considerations

Crew Performance -- Measures of crew performance made during tactical scenario execution

Participant Debriefings -- Form for debriefing all testbed participants at the conclusion of the testbed.

Scenario descriptions. Two utility helicopter tactical missions were used for the crew-level evaluations and to assess changes in crew mission performance. The baseline evaluation was conducted prior to the crew coordination training (pre-training condition). The second evaluation was administered after the training (post-training condition). The two missions were very similar in difficulty in terms of time stress, navigational demands, quantity and capabilities of simulated threat, etc. The objectives and tasks incorporated into the scenario were all made to present two equally difficult missions to the aircrews.

Testbed participants. Four IPs and four UTs received training to present the Aircrew Coordination Student Course and to perform the pre- and post-training evaluations. Sixteen two-person aircrews were battle-rostered for the testbed. Even though the sample size for the testbed was rather small, statistically significant results were obtained on many of the variables investigated. This means that stable estimates of what will happen in the larger population of Army aviators in terms of changes from the pre- to post-training condition were obtained. As will be shown, these results speak very positively of the military worth of the crew coordination training program.

All of the testbed participants listed UH-60 as their primary aircraft and were drawn from the 5th and 9th Battalions of the 101st Aviation Brigade (Air Assault) and the 2nd Squadron, 17th Cavalry Regiment. Thirty-one of the 32 aviators had a Readiness Level 1 rating; one aviator was Readiness Level 2. The participants' experience level was sufficiently broad. Table 1 presents a description of the testbed participants.

Table 1

Rank and Experience Level of Testbed Participating Aviators

	Instructors	Aviators
Rank		
1LT	0	2
CW3	1	0
CW2(P)	3	0
CW2	4	15
WO1		15
UH-60 experience		
Range	500-2300 hrs	70-1850 hrs
Mean	1219 hrs	513 hrs
Time in unit		
Range	1-37 mos	1-48 mos
Mean	19 mos	15 mos

Testbed schedule. The testbed schedule is graphically presented in Figure 2. The first step in the testbed was for project staff trainers to instruct the participating IPs and UTs. After receiving instruction, the IPs (not UTs) rated the 16 battle-rostered participating aircrews during a full (premission, flight, and postmission) simulator session. This was the "pre-training" evaluation designed as the baseline against which performance improvements would be measured. The 16 aircrews were divided into two groups of 8 for the classroom instruction. Two teams each consisting of two IPs and two UTs were formed to team-teach the classroom instruction. The instructor teams also

instructed the aircrews during the two course-related simulator training missions. It should be noted that the IP/UT cadres prepared for the classroom presentations and developed the simulator scenarios for the training missions during very busy schedules; they were not relieved of operational requirements during the month-long testbed. This was a very demanding period for them. Subsequent to the training, another evaluation mission, the post-training evaluation, was given to each of the 16 aircrews. The eight crews given scenario one for the pre-training mission were given scenario two for the post-training mission and vice versa. Again, crews were rated using the measures described above. When the evaluation missions were completed, all testbed participants were debriefed on the testbed and asked to critique the training.

Overview of Report

The remainder of this report is divided into four major sections. The "Results of the Testbed" section briefly discusses each of the measures used in the validation testbed and the results for the pre-training and post-training evaluation missions. Where appropriate, frequency tables of the results of administering each measure are provided in an appendix.

The "Operational Safety Implications" section is divided into two parts. The first part is a discussion of the impact of the validation testbed on "marginal" crews, that is crews who performed particularly poorly during the pre-training evaluation mission. The second part is a discussion of the potential relationship between the data collected during the validation testbed and other Army-sponsored studies.

The last two sections present recommendations for fielding the crew coordination training and evaluation packages, recommendations for future research in the area of crew coordination, and several issues on the future of the USAAVNC's crew coordination project.

Results of the Testbed

This section describes each measure used in the validation testbed and the results from the pre- and post-training administration of the measures.

The Army Aviation Crew Member Questionnaire

The questionnaire administered to the testbed participants has its origins in the commercial world; it has since been revised several times.

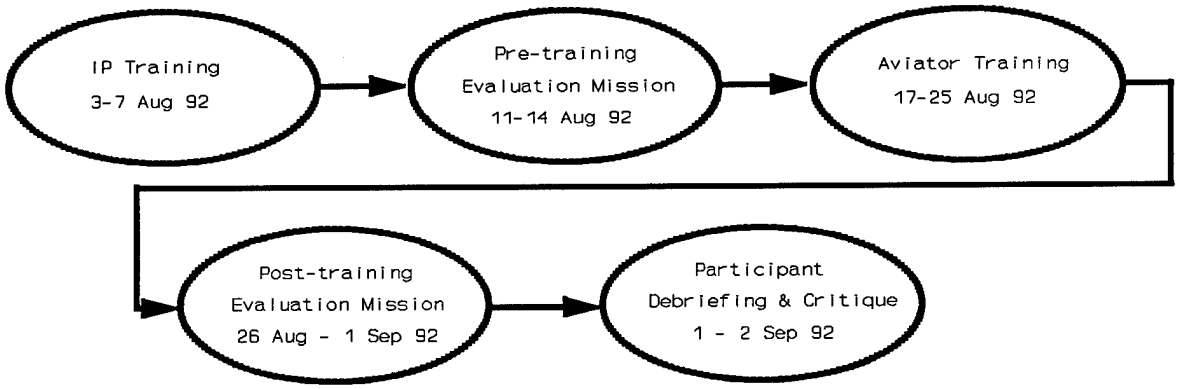

Figure 2. Testbed activities schedule.

The commercial aviation questionnaire, the "Cockpit Management Attitudes Questionnaire" (CMAQ), (Gregorich, Helmreich, & Wilhelm, 1990) was modified for use by the Army. This questionnaire is also referred to as the "Army CMAQ: (Simon, et al., 1992). Although "CMAQ" is a term widely understood by DoD and commercial aviation evaluation research specialists, the project staff believed that a more innocuous name for the attitude questionnaire would be desirable, hence its current name, the Army Aviation Crew Member Questionnaire.

The Army Aviation Crew Member Questionnaire is slightly different than the one Simon reported in 1992; several questions were revised and others added based on lessons learned from previous data collection efforts. The current version includes 46 statements for which aviators are asked to rate the extent of their agreement or disagreement on a seven-point scale. Also included in the questionnaire is a section used to collect background data from the respondents. The current version of the Army Aviation Crew Member Questionnaire is presented in Appendix A.

The Army Aviation Crew Member Questionnaire is used to assess three primary attitudes associated with crew coordination. Table 2 presents the names, definitions, and example items for each attitude area assessed.

Results of the attitude questionnaire. Item-by-item results in the form of frequency tables for the items composing the Army Aviation Crew Member Questionnaire are presented in Appendix A. The questionnaire was administered twice: once at the end of the pre-training evaluation mission (baseline) and a second time at the end of the post-training evaluation mission. Thus, each item

has two frequency tables associated with it: one for the pre- and one for the post-training evaluation. As can be seen, although the Army aviators in our sample generally had a favorable attitude toward crew coordination in both the pre- and post-training conditions, post-training attitudes were usually more favorable.

Table 2

Definitions and Example Items for the Army Aviation Crew Member Questionnaire

Subscale name and definition	Example items
Communication & Coordination An orientation toward interpersonal awareness, communication, and crew coordination	• Good crew communication and crew coordination are as important as technical proficiency for the safety of the flight. • The pilot-in-command should use his crew to help him maintain situation awareness.
Shared Leadership An attitude toward the appropriateness of sharing responsibility for leadership	• Pilots-in-command who accept and implement suggestions from the crew lessen their stature and reduce their authority. • Crew members should be able to anticipate requirements as the mission progresses.
Recognition of Stressor Effects An attitude accepting that human performance is affected by external events and allowance must be made for changed performance	• Crew Member task overload usually occurs because the crew member is not very competent. • Each crew member should watch for situations in which external events limit others' performance.

To capture more precisely the differences in attitudes between the pre- and post-training conditions, four scales were created. Scale scores were computed for the 3 attitude areas assessed by the Army Aviation Crew Member Questionnaire, and a total score was computed for all 46 items. Several steps were taken to compute the scores. First, negatively worded items were recoded. Twenty-three items were worded in the negative such that a response indicating disagreement was the desirable or "correct" response and a response indicating agreement represented an undesirable attitude. Each of these items was recoded so that 1=7, 2=6, 3=5, 5=3, 6=2, and 7=1. Table 3 shows the items in each of the subscales and the direction of the desired response.

Table 3

Items Composing the Three Attitude Scales with Notations[a] for Negatively Worded Items

Army Aviation Crew Member Questionnaire scale name	Items in the scale
Communication & Coordination	1, 2, 3, 4, 5, 7, 9, 11, 12, 16, 20, 21, 22, 24, 27, 28, 31[a], 35, 37[a], 38[a], 41[a], 42
Shared Leadership	8[a], 13[a], 17[a], 18[a], 19[a], 23, 26[a], 29[a], 30[a], 33[a], 34[a], 36[a], 40[a], 44, 46
Recognition of Stressor Effects	6[a], 10, 14[a], 15[a], 25[a], 32[a], 39, 43[a], 45[a]
Whole Questionnaire	1 through 46

[a]The desired response for these items was in the direction of "disagree." They were recoded so that the desired response would appear positive; thus, scale comparisons could be made because higher scores denoted better attitudes.

Cronbach's alpha (a reliability coefficient based on internal consistency) was computed for each scale. The reliability coefficients for the scales were: Communication & Coordination, .76; Shared Leadership, .59; Recognition of Stressor Effects, .52; and for the entire questionnaire, .76. Although these coefficients are only moderately good, they are similar to those obtained with the commercial version of the CMAQ (Simon et al., 1992).

Next, average item scores for each scale were computed for the pre- and post-training conditions. The scale scores were compared using a paired t-test to determine whether the difference was significantly different from one administration to the next. The robustness of the parametric t-test was considered in selecting the statistical method for analyzing the ordinal scale data. Table 4 shows the means of the pre- and post-training administrations and whether the difference between the two is statistically significant.

There was an attitudinal improvement between the pre- and post-training evaluation sessions. The Communication and Coordination scale resulted in less change than the other scales. There may be several explanations for this small difference. It may be that the Army currently teaches some of the values associated with Communication and Coordination in other courses. Perhaps the testbed aviators were "test-smart" about these items and tried to second guess the answer they thought was the desirable or respectable attitude. It is also noteworthy that the Communication and Coordination subscale had the highest average scores; thus, a statistical "ceiling effect" may exist for this subscale. In any event, the change for the subscale is

Table 4

Comparison of Mean Item Scores for Pre- and Post-training Administrations of the Army Aviation Crew Member Questionnaire

Attitude scale	Pre-training		Post-training
Communication and Coordination	5.97		6.07
Shared Leadership	5.57	**	5.78
Recognition of Stressor Effects	4.51	*	4.70
Whole Questionnaire	5.55	**	5.71

*$p < .05$. **$p < .01$.[1]

in the right direction so, at a minimum, the training served to reinforce existing attitudes. The other two subscales, Shared Leadership and Recognition of Stressor Effects, showed significant positive improvement from the pre- to postadministrations. It is thought that because these notions may be relatively novel for the testbed aviators, and because the training presented new conceptual information, the aviators did not try to, or could not, "second-guess" the desired response. Furthermore, there was less of a ceiling effect on these two subscales.

An understanding of the concept of Shared Leadership requires a mature crew member who willingly assumes responsibility for mission safety and success regardless of whether he is the pilot-in-command, the pilot, or the flight engineer. This individual is not concerned about preserving personal rank or status as much as he is concerned with mission effectiveness and safety. He also considers his fellow crew members to be an important resource and that they must be respected and used as valued members of the team.

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[1]For this table and subsequent tables, significant change * for $p < .05$ and ** for $p < .01$. This means that if we were to run a testbed under similar conditions again, the difference between the pre-training score and the post-training score would be as large as the differences found at Fort Campbell 95 out of 100 times or 99 out of 100 times.

The reader is encouraged not to confuse statistical significance with real-world significance. Statistical significance deals with the repeatability of the findings. Practical (real-world) significance has to do with whether the findings will make a difference to real world users.

An understanding of the notion of Recognition of Stressor Effects requires an aviator who knows that neither he nor his fellow crew members are superhuman. This individual knows that human errors are a fact of life and that everyone makes mistakes from time to time; he knows that errors should be corrected with a minimum of disruption to ongoing tasks, mission execution, or team relationships. Furthermore, this aviator knows that overloads increase the risk of errors and poor mission performance; providing support to overloaded crew members is essential to effective mission execution.

Overall, testbed participants' crew coordination attitudes improved significantly as a result of the crew coordination training. Commercial airlines, which offer their own versions of crew coordination training and use a version of the CMAQ to evaluate their training, define success as a positive shift in attitudes. If we applied the commercial airline standard to this Army program, the Army's program would be deemed successful.

Although a positive shift in attitudes is desirable, it is not sufficient to warrant a major investment in training and retraining Army aircrews. For this reason, DRC was asked to evaluate changes in measurable behaviors, crew-level performance, and, to the extent possible, the impact on safety of the crew coordination training. The next sections report on those results.

Basic Quality Ratings: The Aircrew Coordination Evaluation (ACE) Checklist

The ACE Checklist is a behavioral measure that was developed by ARIRWARU and DRC (Simon, 1992). Based on the results of an earlier testbed and guidance from the USAAVNC Working Group, the ACE Checklist was revised (Grubb et al., 1993) for use in the training and evaluation materials at the 1992 Fort Campbell testbed. The most obvious change stemming from the Working Group's guidance was that the old version had 19 "dimensions," whereas the new version has 13 "Basic Qualities." The USAAVNC felt that the Army aviation community would better understand the term "basic quality" than it would the term "dimension" because "basic quality" is used during initial entry rotary-wing (IERW) training. The USAAVNC Working Group also felt that reducing the number of Basic Qualities would make the instrument more manageable.

The USAAVNC Working Group divided crew coordination behaviors into macro- and micro-level behaviors. Macro-level behaviors are evaluated through the ACE Checklist and are oriented toward human relations in the cockpit and how crew members perform as a team. Micro-level behaviors are captured by evaluating performance tied to specific task standards associated with individual ATM Tasks. The Working Group took the position

that both the macro and micro perspectives must be applied to effectively understand the degree to which crew coordination is implemented in the cockpit.

Each Basic Quality was designed to be rated by an IP-evaluator on a seven-point scale. The seven-point scale was anchored at the 1, 4, and 7 levels with specific behavioral descriptions of performance at those levels. IPs were instructed to extrapolate ratings of 2, 3, 5, and 6 from the descriptions given at the 1, 4, and 7 levels as being somewhat better or worse than the anchored description. The numbers associated with the Basic Quality ratings were 1 = Very Poor, 2 = Poor, 3 = Marginal, 4 = Acceptable, 5 = Good, 6 = Very Good, and 7 = Superior. IPs provided the Basic Quality ratings on a grade slip designed for the testbed. The directions for using the ACE Checklist are provided in Appendix B.

Results of the Basic Quality ratings. Item-by-item results in the form of frequency tables for the Basic Qualities composing the ACE Checklist are presented in Appendix B. Because the Checklist was administered twice, once during the pre-training evaluation ride (baseline) and a second time during the post-training evaluation ride, each Basic Quality has two frequency tables associated with it.

Table 5 shows a comparison of Basic Quality item means between the pre- and post-training evaluations. It also shows a comparison between all the ACE Checklist item means. Cronbach's alpha for the overall scale was .95, an extraordinarily high coefficient that attests to the dependability of the ratings derived from the ACE Checklist. Ratings were compared using a paired t-test to determine whether the Basic Qualities significantly improved between the pre- and post-training evaluation missions.

Table 5 shows that there was improvement in every Basic Quality. Despite the small sample size, statistical significance was reached on 12 of the 13 Basic Qualities. On average, crews moved from a rating of "marginal" to "acceptable" within the limited timeframe of the testbed. The goal of the testbed training was to achieve a rating of "acceptable." Good crew coordination requires practice, therefore, continued training is required to move beyond the "acceptable" level of performance. The testbed participants verified this understanding during the testbed debriefing sessions; they expressed a desire to have more training time to achieve better ratings. Once the aircrew coordination program is fielded and continuation training becomes routine, higher levels of performance should be readily achievable.

Table 5

ACE Checklist Basic Quality Comparisons between Pre- and Post-training Evaluation Missions

	Basic Quality	Pre-training		Post-training
1	Establish and maintain flight team leadership and crew climate	3.9	**	5.1
2	Premission planning and rehearsal	3.1	**	4.6
3	Selection of appropriate decision making techniques	3.2	**	4.3
4	Prioritize actions and distribute workload	2.9	**	4.4
5	Management of unexpected events	2.9	**	4.1
6	Statements and directives clear, timely, relevant, complete, and verified	3.1	**	4.4
7	Maintenance of mission situational awareness	2.8	*	3.8
8	Decisions and actions communicated and acknowledged	3.3	**	4.6
9	Supporting information and actions sought from crew	3.3	**	4.2
10	Crew member actions mutually cross monitored	2.7	**	3.9
11	Supporting information and actions offered by crew	3.2	*	4.2
12	Advocacy and assertion practiced	3.2	**	4.1
13	Crew-level after-action reviews accomplished	3.7		4.2
All 13 Basic Quality Ratings		**3.2**	**	**4.3**

*$p < .05$. **$p < .01$.

Although it is pleasing to note the remarkable success the testbed aviators demonstrated subsequent to the training, it is noteworthy that Basic Quality 13 was not well evaluated. The pre-training scores for Basic Quality 13 were relatively high and little movement occurred between pre- and post-training. The primary reason for this weakness is that there is no ATM Task with which after-action reviews are associated; that is, there

are no "micro-level" behaviors or activities to guide the process. Thus, it is difficult for IP evaluators to adequately assess performance on this Basic Quality. This problem can be rectified by (a) including after-action reviews in the ATM for each aircraft and (b) improving the training and evaluation methods for after-action reviews in the field exportable packages. Based on this lesson-learned at Fort Campbell, DRC has improved the training and evaluation materials for Basic Quality 13. To complement this improvement, the USAAVNC should take action to include it in the ATMs.

ATM Task Ratings

ATM Tasks contained in the Final Approved Draft of the newly revised ATM for the UH-60, TC 1-212 (Department of the Army, July 1992) were used as a measure of behavior and performance during the validation testbed. Following the line of reasoning mentioned previously, the ATM Tasks represent the micro-level behaviors required to effectively implement aircrew coordination. Many of the ATM Tasks also have specific performance criteria (standards) which must be met. All ATM Tasks include both a crew coordination and a technical flight skill component. IP-evaluators rated crews on various ATM Tasks but were required to rate crews on 18 selected tasks for each evaluation mission. The 18 tasks were selected for the following reasons:

- They provided a common means for comparing crews on pre- and post-training evaluation missions.

- The project staff felt the 18 tasks were crew coordination intensive.

- The 18 selected tasks were represented in the tactical scenarios constructed for the testbed.

Three forms were used to record ATM Task and Basic Quality performance: (a) DA Form 7172-R, March 1992, entitled Battle-Rostered Crew Evaluation/Training Grade Slip (Department of the Army, July 1992); (b) the Aircrew Coordination Training Grade Slip (Grubb et al., 1993) which was specifically revised for the testbed based on DA Form 5700-R entitled Maneuver/Procedure Grade Slip for the UH-60 RCM (Department of the Army, July 1992); and DA Form 4507-2-R, May 1987, entitled Continuation Comment Slip (Department of the Army, July 1992). For purposes of this report, these three forms are collectively referred to as the grade slip. Blank grade slips are provided in Appendix C. Note that Basic Quality ratings are recorded on page 2 of the Aircrew Coordination Training Grade Slip.

The grade slip used for the testbed required space for several new pieces of information:

• The IP-evaluators needed to record administrative information.

• The IPs were asked to provide an overall grade for the flight. The exact criteria, that is the weighting of technical flight skills, crew coordination, and mission accomplishment, were determined by the IP.

• IPs rated ATM Task performance on a four-point scale: S+, S, S-, and U.[2]

• When a crew received a rating of S- or U due to a crew coordination deficiency, IPs noted two Basic Qualities contributing to the problem. IPs were encouraged to generously utilize the comment section for use during the aircrew debriefs and to provide notes to the project staff about other concerns regarding the flight or the rationale for providing certain grades.

Results of the ATM Task grades. Item-by-item results in the form of frequency tables for the 18 ATM Tasks and the overall grade for the flight are presented in Appendix C. The ATM Task grades were translated for computer analysis so that S+ = 3, S = 2, S- = 1, and U = 0. The grade slip was administered twice: once during the pre-training evaluation mission (baseline) and a second time during the post-training evaluation mission; therefore, each ATM Task has two frequency tables.

Table 6 shows a comparison between each of the 18 ATM Task grades and the overall grade for the flight on the pre- and post-training evaluation missions. The table also shows a comparison between the average task grade for all 18 ATM Tasks. Cronbach's alpha for the ATM Tasks, taken as one scale, was .87, a very high reliability coefficient. Grades were compared using a paired t-test to determine whether ATM Task grades significantly improved between the pre- and post-training evaluations.

It is noteworthy that performance for every ATM Task improved. Although a sample this small is unlikely to render statistically significant results, nine of the comparisons represent significant improvement from pre- to post-training scores. Project staff noted that several of the IPs tended to emphasize the seven ATM Tasks for which there was statistically significant improvement. The reason the IPs tended to emphasize these tasks was not determined, but this observation and the fact that the post-training scores exceeded the pre-training scores by such a wide margin, indicates that were IPs to provide

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[2]Typically, unit aviators are rated on a two point, S or U, scale. The scale used in the testbed was the same as is used during IERW training.

Table 6

ATM Task Grades Comparisons between Pre- and Post-training Evaluations

	UH-60 ATM Task	Pre-training		Post-training
1000	Crew Mission Briefing	.9	**	2.1
1004	DA Form 5701-R (PPC)	1.8		2.1
1007	Before Starting Eng through A/C Shutdown	1.7		1.9
1016	Hover Power Check	.3	**	1.7
1018	VMC Takeoff	2.0		2.2
1023	Fuel Management Procedures	.3	**	1.3
1028	VMC Approach	1.9		2.0
1068	Emergency Procedures	1.2		1.7
1076	Radio Navigation	1.8		2.1
1081	Nonprecision Approach	1.2		1.7
1083	Inadvertent IMC/VHIRP	1.8		2.1
1095	A/C Survivability Equipment	1.6	*	2.0
2008	Evasive Maneuvers	1.5		1.8
2009	Multi A/C Operations	1.6		1.9
2016	External Load Operations	1.4	**	2.0
2078	Terrain Flight Mission Planning	1.3	**	2.3
2079	Terrain Flight Navigation	.9	**	2.0
2081	Terrain Flight	1.8		2.0
Average Score for the 18 Tasks		**1.4**	**	**1.9**
Overall Grade for Flight		**.8**	**	**1.8**

*p < .05. **p <.01.

concentrated instruction on an ATM Task(s), significant improvement could be obtained. This conclusion has profound safety implications because if the USASC can relay problem ATM Tasks to the field, IPs are clearly capable of improving ATM Task performance, thereby enabling the breaking of safety related error chains within their unit.

The average score for the 18 Tasks improved significantly. Before the training, the crews were able to obtain an S/S- level of ATM Task performance. After the training, the aviators attained an S level of performance. As a group, task-level performance improved by one-half a grade subsequent to the training. The overall grade for flight, a grade composed of an IP-determined mix of technical flying skill, crew coordination, and mission effectiveness, improved by a full grade. That is, on the pre-training evaluation, the average score was less than S-, whereas after the training, the overall grade was nearly S.

Results of the ATM Task Grades and Related Basic Quality Ratings

When an ATM Task was graded S- or U and the problem involved crew coordination, IPs noted two Basic Qualities contributing to the problem. The results of the ATM and related Basic Quality analysis are shown in Table 7.

Table 7 is a useful diagnostic tool to evaluate the specific strengths and weaknesses of a unit's aircrews and of a crew coordination training program. The table shows which ATM Tasks were problems and which Basic Qualities were absent, thus contributing to ATM Task performance problems. There were marked improvements in the following Basic Qualities:

BQ 2 Premission planning and rehearsal accomplished
BQ 3 Selection of appropriate decision techniques
BQ 4 Prioritize actions and distribute workload
BQ 5 Management of unexpected events
BQ 6 Statements and directives clear, timely, relevant, complete, and verified
BQ 7 Maintenance of mission situational awareness
BQ 10 Crew member actions mutually cross-monitored

Several Basic Qualities, some despite their improvement, need to receive increased emphasis from crew coordination trainers and instructors. These include:

BQ 7 Maintenance of mission situational awareness
BQ 8 Decisions and actions communicated and acknowledged
BQ 9 Supporting information and actions sought from the crew
BQ 10 Crew member actions mutually cross monitored
BQ 11 Supporting information and actions offered by crew

Basic Qualities 8 and 9 showed small decrements between pre- and post-training evaluations. Basic Qualities 7 and 10 showed large numerical improvement (-22 and -31, respectively) but were still designated by IPs as areas that need refinement. Taken together, Basic Qualities 7, 8, 9, 10, and 11 are qualities that may suffer from battle-rostering.

Table 7

Less Than Satisfactory ATM Task Performance and Inhibiting Basic Qualities for Pre- and Post-training Evaluation*

Task	BQ1	BQ2	BQ3	BQ4	BQ5	BQ6	BQ7	BQ8	BQ9	BQ10	BQ11	BQ12	BQ13	Totals
1000	2|1	10|3	2|1	7|1					1|0					22|6
1004		1|0	2|1	1|0		1|0	1|0			2|0		0|1		8|2
1007		1|0	0|1	0|1			1|1		1|1	3|0	0|1			6|5
1016		2|0	1|0	4|1		3|1	11|2	1|0	1|3	8|3	1|4			6|14
1018														0|0
1023		1|0	1|0	4|1	0|1	3|1	8|3	0|1	2|1	10|3	1|0			30|11
1028			1|0	1|0	1|0	1|0	2|2			0|1		0|1		6|4
1068			3|2		5|4		2|3	1|1	0|1	3|3	2|1	2|1		18|16
1076	1|0						1|2	0|1		3|0	1|1			6|4
1081		2|0	1|0		1|0	2|1	4|4	0|2	1|3	3|4	5|0			19|14
1083		1|0	1|0	0|1	1|1	2|0	1|2			1|2	2|0	1|0		10|6
1095		2|0	1|0			2|0	4|1			1|1				10|2
2008			2|1	2|0	3|2	1|0	1|4		0|2	1|2	1|1	1|0		12|12
2009		2|1	0|1		2|0	1|0	7|2		0|1	2|0	0|1			14|6
2016		3|0		1|0		1|0	4|2			3|2				12|4
2078	2|0	11|0	2|1	4|1		1|0		0|1	0|1	2|0				22|4
2079		3|1	3|0		7|0	3|0	5|4	0|1	2|1	2|2	1|1			26|10
2081							2|0		0|1	10|0	0|1			12|2
Totals	5|1	39|5	20|8	24|6	20|8	21|3	54|32	2|7	8|15	54|23	14|11	4|3	0|0	265|122

*Within each column, numbers to the left are pre-training and numbers to the right are post-training.

BQ1=Crew climate BQ2=Plan rehearse BQ3=Decision techniques BQ4=Work load BQ5=Unexpected events

BQ6=Positive comm BQ7=Situation awareness BQ8=Comm/acknowledged BQ9=Info sought BQ10=Cross-monitor

BQ11=Info offered BQ12=Advoc/assert BQ13=After-action Review (AAR)

Battle-rostering breeds familiarity. Familiarity can be helpful in the cockpit because crew members know what to expect from one another; they are likely to behave in a manner that can be anticipated by their battle-rostered fellow crew members, and each knows the other's strengths and weaknesses. On the other hand, this familiarity may also breed "assumption creep"--pilots may tend to assume the following when battle-rostering familiarization takes place:

1. The other crew member is maintaining situational awareness because he has always seemed to do so in the past. (Basic Quality 7)

2. Decisions and actions do not need to be as well articulated and verified because the crew has had similar situations and the crew is performing as they previously did under the same or similar circumstances. (Basic Quality 8)

3. Supporting information and actions do not need to be sought because the pilot flying (PF) assumes that the pilot not flying (PNF) or other crew members are providing all the supporting information and actions the PF needs to maintain safe and efficient flight. (Basic Quality 9)

4. Cross-monitoring is less important because one crew member assumes that he knows what other crew members are doing. Crew members automatically assume that the others are performing correctly because they previously performed the same or similar action and things worked out well. (Basic Quality 10)

5. Supporting information and actions do not need to be offered because the other crew members assume that the PF is asking for all the required information and actions he needs to maintain safe and efficient flight. (Basic Quality 11)

To an observer, "assumption creep" may seem to be complacency. The problem cannot be verified within the present data set, but it has been debated within the USAAVNC Working Group.

Looking across the rows in Table 7, one can see that certain ATM Tasks continue to cause problems even after the crew coordination training. Although Table 6, the ATM Task Grades, also shows which ATM Tasks were problematic, Table 7 presents a more informative alternative because it is linked to the Basic Qualities. The following is a list of the ATM Tasks that

continue to cause problems after the training (i.e., those tasks with more than 10 Basic Quality negative notations:

1016 - Hover Power Check (14 negatives)
1023 - Fuel Management Procedures (11 negatives)
1068 - Emergency Procedures (16 negatives)
1081 - Nonprecision Approach (14 negatives)
2008 - Evasive Maneuvers (12 negatives)
2079 - Terrain Flight Navigation (10 negatives)

Collectively, these six ATM Tasks accounted for 77 (63%) of the negative notations. Given this type of information, a unit commander would know which ATM Tasks needed to be emphasized in his crew coordination training program. As previously stated, when IPs emphasized specific ATM Task performance during the training, it was observed that crews markedly improved their performance of those tasks.

Mission Performance and Efficiency

Testbed aircrews were given a utility helicopter tactical mission to perform in the UH-60 flight simulator. Data was collected from the two evaluation missions (pre- and post-training) to determine whether mission performance was enhanced as a result of the validation testbed. Important components of mission performance were scrutinized, but the central question was "What is the military worth of the crew coordination training program?"

Two scenarios were developed for the testbed evaluations. Project staff attempted to equalize the difficulty of the scenarios. Assignment of crews to a scenario was experimentally "counterbalanced" so that there was a 50-50 split for each scenario for both the pre- and post-training evaluation. This experimental design technique was implemented so that in the pre-training evaluation, eight crews were assigned scenario one, and eight crews were assigned scenario two. For the post-training evaluation, those crews who had received scenario one in the pre-training evaluation were assigned scenario two, and those who had previously received scenario two were assigned scenario one. In this way, scenario assignment was completely counterbalanced and results were viewed by looking at group performance for the pre- or post-training evaluations without any effect of scenario assignment on group-level performance.

A diagram of scenario two is presented in Figure 3 as an example of the two scenarios. The mission scenario consisted of five phases:

1. Phase 1 (Planning) -- Premission Planning: Crews had 1.5 hours mission planning time before entering the simulator. This phase included the mission briefing and all preparatory tasks associated with planning a tactical mission. The tasks included terrain flight mission planning, performance planning, assigning crew member responsibilities, and all required briefings and brief-backs. The phase ended when the crew completed all of the briefings and entered the simulator.

2. Phase 2 (Positioning and Form Up) -- Movement from the Assembly Area (AA) to Pickup Zone: Starting at the AA, the crew flew to pickup zone 1 (PZ1) to load troops for the cross-FLOT air assault mission. Phase 2 included an aircraft system malfunction, which should have resulted in a precautionary landing at PZ1. The phase ended when the crew completed the precautionary landing. While loading troops at PZ1, an exact was time ("hard time") to deliver the troops at landing zone 1 (LZ1) was given to the crew.

3. Phase 3 (Air Assault) -- Cross-FLOT air assault from Pickup Zone 1 to Landing Zone 1 to Release Point 2: Acting as lead ship in a flight of five aircraft with no changes in lead or formation, the assault involved moving troops along a prescribed route in a medium-to-high threat environment. The crew entered corridor number 1 by crossing start point 1 (SP1) - (SP1 - which is where timing started for segment one of the mission). The crew made its way through air control point (ACP) 1, 2 and 3. Upon arrival at release point 1 (RP1), the crew called in its arrival to a Maneuver Task Force Headquarters to determine whether to deliver the troops to the primary or alternate LZ. In this scenario, crews were told to go to the designated alternate LZ1. After delivering the troops as close as possible to the hard time, the crew flew past SP2 into corridor 2, past ACP4 and to RP2 where timing for segment 1, the cross-FLOT air assault portion of the mission, ended. The phase ended at PZ2. The segment also included a minor malfunction (fuel leak) that was administratively removed as soon as the crew detected and verbally recognized it.

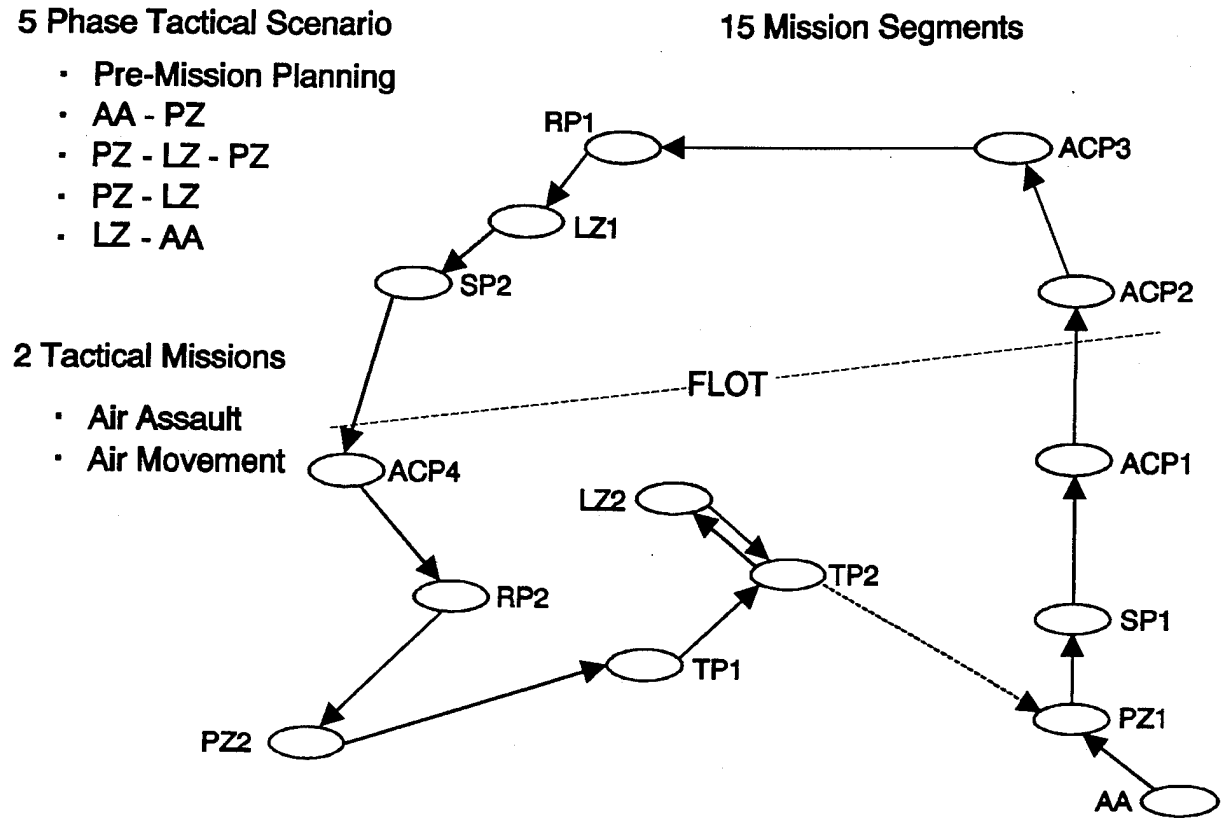

Figure 3. Diagram of mission scenario two.

4. Phase 4 (Air Movement) -- An external load air movement from Pickup Zone 2 to Landing Zone 2: The crew executed the air movement portion of the mission by proceeding to pick up a sling load (an M-102 howitzer with A-22 bag) in PZ2 to resupply a friendly unit located near the FLOT. After picking up the load, the crew flew along corridor 3 past turn point (TP) 1 and 2 on its way to the planned LZ for delivery. The crew was to accurately navigate within the prescribed corridors while avoiding and evading threat.

5. Phase 5 (Return to Base) -- Landing Zone 2 to Assembly Area: After delivering the howitzer, the crew entered corridor 4 by flying back the way they had come, through TP2 on their way to AA, which was the planned end to the mission. After reaching TP2, the crew encountered inadvertent instrument meteorological

conditions (IMC), performed vertical helicopter instrument recovery procedures (VHIRP), and executed a nondirectional beacon (NDB) approach to a recovery airfield. The crew planned and executed the nonprecision approach to transition back to visual meteorological conditions (VMC). The phase ended when the crew completed a safe landing.

During the mission, the crews encountered threat in the form of anti-aircraft guns (ZSU 23-4) and missile sites (SA7/8). For the most part, threat was minimal if crews stayed within the assigned corridors. When crews encountered threat warnings, they had to take evasive action or risk being engaged.

Two emergencies, one minor malfunction and one major emergency, were programmed into the scenario. The minor malfunction was a slow fuel leak. As mentioned above, as soon as a crew member announced awareness of the leak, the simulator instructor operator stopped it. The major emergency was a decreasing rotor RPM that would force a landing "as soon as practicable." The emergency occurred in a place where the optimal landing area was PZ1 and was administratively corrected once on the ground. No negative mission impact was experienced.

Mission performance data collection. Project staff measured mission performance using a variety of data collection techniques. Each simulator mission was recorded using four video cameras multiplexed onto one video picture. All intercom and radio communications and aural warnings were recorded onto the videotape. Two cameras were situated in the cockpit aimed at each of the aviators. A third camera was placed in the simulator computer room and aimed at a specially programmed display to capture critical flight parameters: altitude, airspeed, and heading. The fourth camera, also in the simulator computer room, was aimed at a high resolution monitor that displayed the right seat's forward windscreen out-the-window view. Figure 4 shows what was seen on the video display monitors and recorded for later review.

During each simulator mission, two members of the project staff used a small computer and data entry software to create computer-generated log files of mission critical events in near-real time. The computer clock was software controlled to synchronize log file entries with the videotape clock so that both the videotape and the log file recorded mission times from time zero. The log file contained such things as times of departure and arrival at various points, threat encounter

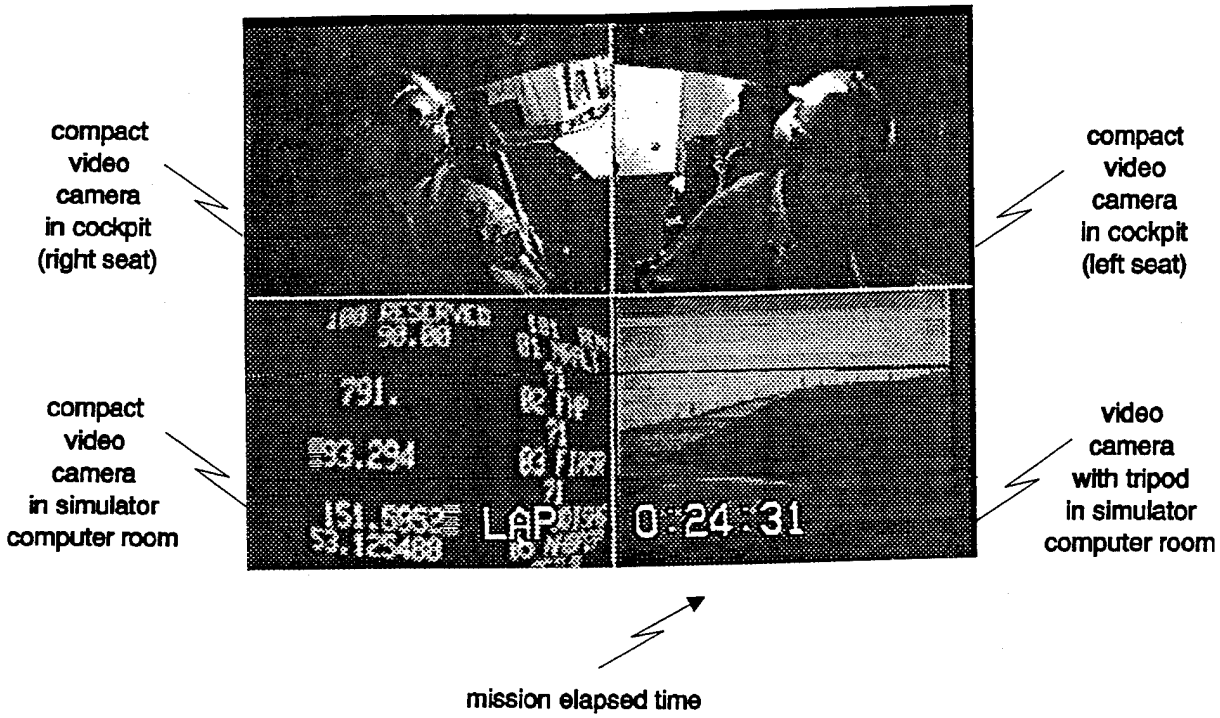

Figure 4. The data collection video scene: Four cameras combined onto one video display.

duration and outcome, timing and ratings of emergency procedures, instrument recovery flight parameters and crew interactions, whether there was an occurrence of a crew-caused mission threatening error, how much of the mission was accomplished by the crew, and various, *ad hoc* comments by the observers.

Simulator-generated plots of flight profiles were used to reconstruct the exact flight path of the aircraft. The plots also showed which enemy threat systems were activated throughout the mission.

IP-evaluators kept track of the mission using evaluator worksheets. The evaluator worksheets contained an outline of the mission, mission segment descriptions, and ATM Tasks associated with each segment. The IPs used the worksheets to record crew performance regarding the ATM Tasks and the Basic Qualities. IPs also recorded how well crews performed required emergency steps, when the minor malfunction was detected, and heading and altitude deviations on the IMC approach. (Note: Where possible, such as

for the IMC approach, project staff confirmed IP observations through post-testbed review of the videotapes.)

Mission performance - Data analysis. Mission performance data were analyzed according to the following categories: navigation, threat, emergencies and malfunctions, instrument recovery, and overall mission performance. Some of the analysis required extensive review of the videotapes. On occasion, videotaped events were compared with the log files and the simulator plots.

A short digression at this point is warranted: The data reported in the next several sections is quantitative in nature and the numbers reflect the performance enhancements and the military benefits engendered through the crew coordination training conducted at Fort Campbell. The numbers, however, do not tell the whole story. Project staff and several members of the USAAVNC Working Group have viewed the mission videotapes. Without exception, some of the most impressive aspects of the differences in pre- and post-training conditions were qualitative in nature. Post-training crews work better as teams, they plan better during the premission activities and during the flight, they exchange information better, manage workload more efficiently--taking advantage of one another's talents and skills, and they check each others' performance as the mission unfolds. These crews were "ahead of the aircraft" nearly all of the time. They were in control. Furthermore, when events and the aircraft became troublesome, they handled problems efficiently and with mission objectives in mind. The qualitative change in the cockpit was striking.

In the following sections, summary tables are presented for each performance measurement area. In most cases, the tables consist of four columns: The first column is the variable under consideration; the second and third columns are the pre- and post-training results, respectively; and the fourth column presents a summary statistic showing the change from pre- to post-training. For nearly every performance variable, the change is in the expected direction; there is improvement after the training. However, less is better for some of the variables. For example, it is better to have fewer course deviations, fewer crashes, etc.

Mission performance - Navigation. Results of the analysis of navigation are presented in Table 8 and discussed in the following paragraphs.

Table 8

Pre- and Post-training Evaluation of Navigation Performance Using a t-Test for Correlated Samples

Navigation measure	Pre-training		Post-training
Number of course deviations greater than 500 meters beyond standard	47	*	26
Percent of time off course	44%	**	21%
Number of crews arriving at correct landing zone	10	*	16
Average deviation time for crews arriving at the correct landing zone	4.5 minutes		3.0 minutes
Number of crews arriving within 1 minute of hard time at landing zone	3		7

*$p < .05$. **$p < .01$

Number of course deviations greater than 500 meters beyond standard: The four planned corridors were one kilometer wide. A deviation was counted when crews strayed outside the corridor more than 500 meters. On occasion, crews purposely left the corridor to avoid a threat system. These avoidance maneuvers were not counted against the crew if they (a) knew they were making an excursion and (b) were able to reorient onto the planned course after the threat subsided. Crews deviated from the corridor 45% less in the post-training evaluation than they did in the pre-training evaluation.

Percent of time off course: Once a course deviation (as defined in the previous paragraph) occurred, crews attempted to reorient the aircraft back onto the course. Pre-training crews spent 44% of their time misoriented, whereas post-training crews spent only 21% being misoriented, an improvement of 23%.

Number of crews arriving at the correct landing zone: Crews were told to deliver troops to a specific LZ. Only 10 of 16 pre-training crews arrived at the correct LZ, whereas 16 of 16 crews

arrived at the correct LZ in the post-training evaluation. This represents a 38% improvement in being able to deliver troops to the correct place.

Average deviation time for crews arriving at the correct landing zone: Crews were given a "hard time" to arrive at the LZ. This measure shows, on average, how close crews came to meeting the hard time. More precision is better than less. During the pre-training evaluation, crews deviated (+ or -) an average of 4.5 minutes from the hard time; during the post-training evaluation, crews deviated an average of 3.0 minutes, representing a 33% improvement.

Number of crews arriving within 1 minute of hard time at landing zone: Because no Army-wide standard exists for meeting a hard time, allowable deviations are locally and situationally determined. The reasons for this precision vary, but in the testbed mission when crews were performing a cross-FLOT air assault, accompanying attack helicopters were scheduled to place preparatory fires on the LZ 1 minute prior to the hard LZ time. In the second scenario, a second lift element was due to arrive 3 minutes after the first lift. All of these operational factors made timing critical and the aircrews were briefed on the importance of accurately meeting the hard time. Only three pre-training crews arrived within the 1 minute window, whereas seven post-training crews (nearly 50% of the crews) arrived within the 1 minute window. This represents a 25% improvement from pre- to post-training evaluations.

Mission performance - Threat. The simulator scenarios were constructed with antiaircraft gun and missile threat systems activated. The location of the threat sites were chosen so that, for the most part, when crews stayed within the assigned corridors and altitude, few or no threat systems were encountered. Project staff, acting as observers, recorded each threat system encounter in the computerized logger file. Each encounter was logged and time-stamped. Subsequent to the testbed, every threat encounter was reviewed using the mission videotapes.

Three considerations guided the analysis of the videotapes. First was the warning state. There are three warning states of the APR-39 in the UH-60 cockpit: search, track, and weapons activity. The analysis counted only track and weapons activity as a valid warning or encounter. Second was the length of the warning. Although there is no Army-wide standard regarding an

acceptable length of a threat encounter, members of the USAAVNC Working Group and Fort Campbell IPs informed the project staff that 10 seconds was a good rule-of-thumb for acceptability--more than 10 seconds presents extreme danger to the crew. Thus, encounters greater than 10 seconds were tabulated. The third consideration for each threat encounter was the outcome. There were two outcomes in the analysis. The good or acceptable outcome was "broke lock." A detrimental outcome was defined as either became lost or misoriented, crashed, or took hits. Based on these three considerations (number of warnings, duration of warning, and outcome), four rating criteria were established for the testbed aircrews. These criteria are presented in Table 9.

Table 9

Rating Criteria Used for Threat Encounters

Rating	# of warnings	# of warnings > 10 seconds	# of detrimental outcomes
3 = Superior	4 or fewer	0	0
2 = Good	8 or fewer	1 or fewer	0
1 = Marginal	12 or fewer	2 or fewer	1 or fewer
0 = Very Poor	More than 12	More than 2	More than 1

The four ratings shown in Table 9 were used so that a crew had to meet all three criteria to make a rating (i.e., an "and" Boolean operator was used). For example, a crew with four or fewer warnings, one of which was greater than 10 seconds, and with no detrimental outcomes, would be given a rating of "good". A crew with eight or fewer warnings, none greater than 10 seconds, that became misoriented as a result of taking evasive maneuvers, would be given a rating of "marginal."

Results of the analysis of threat encounters are presented in Table 10. During the post-testbed analysis, it became evident that the threat was not working properly for three of the crews during the pre-training evaluation. Therefore, only 13 crews were rated during the pre-training evaluation, whereas 16 crews were rated on the post-training evaluation.

Table 10

Pre- and Post-training Evaluation of Threat Encounters

Measure	Pre-training	Post-training
Crews receiving a "superior" or "good" rating	7 of 13 (54%)	11 of 16 (69%)

As shown in Table 10, the improvement from pre- to post-training ratings was 15%. Other positive changes from pre- to post-training evaluations were also recorded. For example, there were only four pre-training "superior" ratings, but there were six post-training "superior" ratings; and although there were four "very poor" ratings on the pre-training evaluation, there were only two such ratings on the post-training evaluation. Of the six crews receiving a "marginal" or "very poor" rating on the pre-training evaluation, five crews improved. With these additional pieces of information in mind, it is safe to conclude that the 15% improvement in dealing with threat is a conservative estimate of the improvement as a result of the testbed training activities.

Mission performance - Emergencies. During the missions, crews were given two types of unexpected aircraft system malfunctions: One was minor (a slow fuel leak that was stopped as soon as a crew member announced the problem), and the other was a major emergency that entailed either an increasing or decreasing rotor RPM. The major emergency required the crew to work in concert to identify and isolate the problem and to successfully complete a landing as soon as practical. Table 11 presents the outcomes of these measures.

Number of crews detecting minor malfunction: This measure is an excellent assessment of the crews' situational awareness and ability to effectively manage workload. Crews did far better on this measure subsequent to the crew coordination training.

Number of crews correctly diagnosing major emergency: There was a minor decrement in performance from pre- to post-training evaluations on this measure. The technical nature of the major emergency presented the crew with an uncertain situation. Because the aircraft gross weight was light and airspeed was low, there was a low power demand; thus, the emergency did not always cause continuing loss or gain in rotor RPM (decreasing or

Table 11

Results of Pre- and Post-training Evaluation of Aircraft Emergencies

Measure	Pre-training		Post-training
Number of crews detecting minor malfunction	10	**	16
Number of crews correctly diagnosing major emergency	12		11
Number of crews with a safe landing subsequent to the aircraft emergency	16		16

**$p < .01$

increasing % rotor RPM). In those cases where RPM stabilized within acceptable parameters, crews often believed that they had experienced a different emergency; usually they thought a torque split had occurred. As a result, crews did not always properly diagnose the emergency or complete the emergency procedure, which was to place the affected engine's power lever to environmental control unit (ECU) lockout position. Qualitative data, based on videotape review, shows improvement in crew interactions while coping with the major emergency and confirms the modest improvement in emergency procedure ATM Task performance.

Number of crews with a safe landing subsequent to the aircraft emergency: All crews remained unscathed subsequent to the aircraft emergency in both the pre- and post-training evaluations. Some investigation was required to explain this measure and the one above: number of crews correctly diagnosing the major emergency. It was expected that crews would improve on these two measures, but they did not. One reason for this may be that emergency procedures are often practiced in the simulator; thus, aircrews expect emergencies in the simulator environment because they routinely practice emergency procedures there. Another reason may be that the emergency presented in the scenario was relatively benign; that is, there was little danger of crashing and losing the aircraft. If a more serious emergency had been scripted into the scenario, such as loss of hydraulics, the outcome might have been different.

The lack of results on the above two measures is not critical. The primary reasons for scripting emergencies into the scenarios were (1) to present aircrews with stressful situations in which crew coordination would be useful and (2) to provide IP-evaluators with ample opportunity to assess how well aircrews practiced crew coordination. These two objectives were achieved.

Mission performance - Instrument recovery. Instrument recovery is a crew coordination-intensive activity. Crews were measured on their performance of an entry into inadvertent IMC whereupon they had to execute VHIRP and a nonprecision instrument approach using a nondirectional beacon as the only external navigation aid. Several objective measures of their performance were taken, and one rating scale was applied. The rating scale, applied by project staff in their role as observers and later verified by reviewing the videotapes after the testbed, is presented in Table 12.

Table 12

Rating Criteria Used for Instrument Approach Planning and Execution

Rating	Description
3 = Superior	Both crew members review, discuss, and rehearse the approach; PNF assists the PF throughout the approach.
2 = Good	One crew member reviews the approach, briefs the other prior to executing the approach, then talks him through it.
1 = Marginal	One crew member reviews the approach and talks the other through it.
0 = Very Poor	One crew member reviews and executes the approach with no assistance from the other.

The results of measuring instrument recovery performance are presented in Table 13.

Number of crews with all five recovery procedure steps correct: Upon inadvertent entry into IMC conditions, crews had to execute five VHIRP recovery steps to transition to instrument

Table 13

Results of Pre- and Post-training Evaluation of the Instrument Recovery

Instrument recovery measure	Pre-training		Post-training
Number of crews with all 5 recovery procedure steps correct	9		13
Number of crews with successful transition from VMC to IMC	14		16
Rating of approach planning[a]	1.6		1.9
Number of crews with "superior" approach planning	2		5
Number of crews with no altitude deviations greater than 100 ft beyond standard	9	*	14
Number of crews not descending below missed approach point (MAP) early	10	*	15
Number of crews with properly timed inbound leg	11		14

[a]Rating based on the scale presented in Table 12.
*$p < .05$

flight. IPs observed the number of correct steps taken by each crew. In the pre-training ride, 9 of 16 crews (56%) performed all five steps correctly; during the post-training evaluation, 13 of 16 crews (81%) performed correctly, representing a 25% improvement on this measure.

Number of crews with successful transition from VMC to IMC: Two crews did not safely transition from VMC to IMC. They crashed. Although only a small percentage of aircrews improved their performance from pre- to post-training, this is an important measure because it is life and materiel threatening. This leads to an interesting point: Even relatively small improvements may have real-world implications much greater than would first appear.

Rating of approach planning, and number of crews with superior approach planning: Crews were rated on these two related measures as having performed substantially better after the crew coordination training.

The last three items in Table 13, altitude deviations greater than 100 feet beyond standard; not descending below MDA early; and the timing of the inbound leg, all measured how well crews executed the instrument approach. Other measures were considered for use here, such as heading deviations, but were not included because they showed little difference between pre- and post-training performance. They were also considered to be less important than measures such as altitude deviations. There was substantial improvement for each of these measures.

Collectively, the seven measures listed in Table 13 clearly show that the activities associated with inadvertent entry into IMC and instrument recovery improved markedly by the time the crews were evaluated during the post-training ride. Because successful performance of these activities is highly dependent on crew coordination, and performance improved after training, it appears that the training improved the crews' performance.

Mission performance - Overall measures. Several global measures of mission performance dealing with overall mission accomplishment were used. Whereas most of these measures were objective measures of performance, one measure was subjective: "mission threatening error." This measure was created to capture unexpected events that negatively affect mission accomplishment. For instance, during nap-of-the-earth flight, a crew hits the tail wheel on the ground, does not crash, and continues the mission with only limited damage to the aircraft. This type of event would not be reflected in the other performance measures; therefore, a scale was constructed to capture this type of event. The project staff mission observers used this scale and later verified it by reviewing the videotapes. The mission threatening error scale is presented in Table 14.

Table 14

Rating Criteria Used for Mission Threatening Error Scale

Rating	Description
4 = None	No occurrence of mission threatening error.[a]
3 = Satisfactory + S+	Without any damage to the aircraft, the crew completes both the cross-FLOT air assault and external load missions within the time and location accuracy required by the scenario.
2 = Satisfactory S	Minor damage due to terrain strike (e.g., tail wheel contact) or enemy fire (e.g., stabilator hits) or the crew misses the LZ hard time by one to three minutes or releases the external load more than 500 meters from the desired location and/or misses navigation check points. However, this crew reasonably completes all mission objectives.
1 = Satisfactory - S-	Aircraft damage (e.g., blade strike, enemy fire) occurs that would have interrupted the mission for repairs or the mission is abbreviated due to navigation errors. The crew manages to recover to complete only part of the mission (e.g., deliver troops more than three minutes past the LZ hard time, substitute an internal load for the planned external load).
0 = Unsatisfactory U	Obstacle strike, terrain strike, or enemy fire destroys the aircraft or crew errors (e.g., repeated misorientations) culminate in situations where the crew is unable to recover to deliver the troops or external load within any reasonable time or approximate location.

[a]No crews received a rating of 4. This was expected given the complex, battle-oriented mission that the crews were flying.

To summarize the rating factors in Table 14:

Satisfactory+ (S+)	Everything is fine; all objectives met
Satisfactory (S)	Minor problems; objectives nearly met
Satisfactory- (S-)	Recoverable problems or damage; objectives partially complete
Unsatisfactory (U)	Irrecoverable problems or damage; objectives incomplete

Table 15 presents the results of the Mission Overall measures.

Table 15

Results of Pre- and Post-training Evaluation for Overall Measures

Overall measure	Pre-training		Post-training
Mission threatening error[a]	1.1	*	1.9
Number of crews receiving "S+" or "S" mission error ratings	6	*	12
Percent of mission segments accomplished	66%	**	86%
Number of crews completing cross-FLOT and external load missions	9	*	16
Number of aircraft crashes[b]	7		4

[a]Rating based on the scale presented in Table 14.
[b]Some aircrews had more than one crash.
*$p < .05$. **$p < .01$

Table 15 presents the most compelling evidence of the military benefits of the crew coordination training provided to the Fort Campbell testbed aircrews. The measures focus on how well the crews accomplished the mission and how safely they performed.

Mission threatening error: The testbed aircrews averaged "S-" performance during the pre-training evaluation and "S" performance on the post-training evaluation. In terms of improvement on the rating scale (movement of .8 on the 3.0 scale), performance improved 27%.

Number of crews receiving "S" or "S+" error ratings: This variable is another way of looking at mission threatening error. In the case of the testbed aircrews, six additional crews (more than one-third of the crews) improved their performance so that they received an "S" or "S+" rating.

Percent of mission segments accomplished: This measure was determined after the testbed by reviewing the observer logs, the simulator plots, and the videotapes. Each of the scenarios was divided into segments. There were 15 segments for each evaluation mission. The 15 segments included reaching the air control points, report points, landing zones, etc. (Refer to Figure 3 to see the segments for scenario two.) During the pre-training evaluation missions, crews averaged 66% mission accomplishment; on the post-training evaluation, crews averaged 86% mission accomplishment.

Number of crews completing cross-FLOT and external load missions: This measure, derived the same way as "the percent of mission segments accomplished" (see preceding paragraph), is a "bottom line" number. The two central military objectives of the mission were to perform an air assault and an air movement. Despite any other intervening difficulties, the crews had to attain these two objectives. In the pre-training evaluation, only 66% of the crews accomplished the two objectives. In the post-training evaluation, 100% of the crews accomplished the mission. During the training, crews learned techniques to keep focused on what is important and to deal with emergencies and unforeseen problems in such a way that they do not lose sight of mission objectives. Field commanders should be aware of the statistic for this measure because it is the one that most clearly shows the impact of crew coordination-trained aircrews on military effectiveness.

Number of aircraft crashes: One of the goals of crew coordination training is to enhance the margin of flight safety. The data presented in Table 15 support the idea that safety is enhanced subsequent to the training. Although the results are impressive, one is cautioned against making strong conclusions based on this one data set. First, two crews had more than one

crash in the pre-training evaluation. Second, aviators may be less cautious in the simulator because a crash in the simulator does not cause any real harm. Third, the simulator visuals do not present the rich textural and topographic clues present in the real world. Fourth, the testbed sample is too small to allow for a definite conclusion that 43% of aircraft crashes will be avoided after the crew coordination training. Nevertheless, this measure is important as a safety indicator. At a minimum, it shows that crew-level situation awareness is markedly enhanced after the crew coordination training. Furthermore, it may point to a potential dramatic reduction in accidents.

Summary of findings from aircrew and instructor debriefings. Crew members and instructors were debriefed during the last two days of the testbed. Prior to the debriefs, participants were given the debrief interview questions to make notes on the items they wanted to discuss during the debriefs. Many of the participants wrote answers to the interview questions and gave them to the project staff.

Four groups of eight aviators were interviewed during the first day of the two-day debriefing period. Each group debrief took two hours. The project staff recorded each group's responses and discussions. On the morning of the second day, instructors were interviewed in a two-hour, one-on-one situation. In the afternoon, instructors participated in a two-hour group debrief. As in the aviator debriefs, project staff recorded answers and summarized discussions as they took place.

After all the interview data were collected (i.e., participant written responses and project staff notes), the responses were entered into computer files, edited for readability, and then compiled so that similar answers did not appear twice. The results of the analysis are presented in Appendix D.

In Appendix D, the questions are stated, a summary of the responses is given, the detailed responses are provided, and the project staff's reaction to each set of comments is stated. Many of the testbed lessons-learned were generated or reinforced during the debriefs. For this reason, the reader is encouraged to closely examine Appendix D.

In general, as shown in Appendix D, the reaction of the testbed participants was very positive. Summary remarks from the

aviators are provided in Table 16 and from the instructors in Table 17.

Table 16

Summary of Crew Member Exit Interview Remarks

Topic	Remark
Course Administration	• Introduce crew coordination from the unit commander down. • Promote crew coordination standardization rather than familiarization.
Course Structure	• Retain both classroom instruction and simulator or aircraft application. • Understood crew coordination basic qualities. • Case studies and video segments were very effective.
Flight Simulator	• Missions were realistic and demanding. • Videotape review of performance is absolutely necessary.
General Observations	• Glad to see the emphasis on safety. • Include nonrated crew members. • It is good to train and evaluate the crew instead of individual aviators. • I realize that I have a lot to contribute as a crew member. • Got me out of some bad habits. • Increased confidence in self and crew. • Course will probably save my life in the future.

Crew members appreciated being trained and evaluated as a crew rather than as individual aviators. They emphasized the need to get unit commanders involved at the outset to realize maximum benefit from the crew coordination program. Crews suggested that standardized crew coordination training may make

them more effective than battle-rostering familiarization. Crew member participants said that the case studies and video segments were very effective methods to help them understand how the Basic Qualities fit in with the ATMs and crew coordination program objectives. They strongly agreed on the importance of including both classroom instruction and hands-on simulator or aircraft practice sessions as part of the course. Though a number of crews had recently participated in Desert Storm, they agreed that the simulator missions were realistic and demanding. They also strongly agreed that videotape review of their performance is essential to crew coordination training and evaluation. Crews spontaneously shared the positive effect the crew coordination project had on mission safety and effectiveness. They recommended that the course be implemented without delay.

Unit instructor pilots and trainers who administered the crew coordination course of instruction and conducted the evaluations strongly agreed that the program is effective and necessary to implement the new Commander's Guide (Department of the Army, 1992, May) and ATMs. They echoed the crew member's approval of the written and video segment case studies as being effective in augmenting the classroom instruction. As a group, they said that the instructor course should require them to complete the same number of hands-on missions as the crews they teach. Instructors strongly agreed on the importance of videotaping crew performance to demonstrate teaching points and provide evaluation feedback. They said that the revised ATM task for mission briefing (Task 1000, Conduct crew mission briefing) (Department of the Army, 1992, July) is very effective in teaching and evaluating crew coordination and that an after-action review (AAR) task should be developed for all aircraft ATMs.

Testbed IP evaluators were given a job aid in the form of an "evaluators workbook" (Grubb et al., 1992) for use during the pre- and post-training evaluation missions. The evaluator's workbook was endorsed as applicable to all mission phases and all crew coordination training in simulators or aircraft. Evaluators were comfortable using the Basic Qualities and confident in the reliability and fairness of their ratings. They remarked that the crew coordination grade slips and expanded grading system were easy to use and encouraged their unreserved judgements. Evaluator participants considered the crew's positive response and improved performance to be strong indicators that crew coordination can be effectively taught by units in the field.

Table 17

Summary of Evaluator and Trainer Exit Interview Remarks

Topic	Remark
Course of Instruction	• Written and video segment case studies thoroughly enhanced training effectiveness. • Course is effective and necessary to implement the new Training Circulars. • Include all Student Course training and evaluation missions in the Trainer Course.
Scenarios	• Scenarios were well thought out, realistic, and challenging. • Develop an after-action review (AAR) task for all aircraft ATMs. • Videotape review of crew performance is a must-have capability. • Include night flying conditions. • Scenarios addressed all Basic Qualities.
Evaluator's Workbook	• Workbook applies to all phases of a mission. • Supports evaluation of initial and continuation training in simulators or aircraft. • Videotaping is essential to demonstrate teaching points and provide evaluation feedback to crews.
Crew Coordination Basic Qualities	• I used them outside the testbed and am convinced they are comprehensive and distinctly different. • The behavioral anchors allowed me to give fairer ratings. • The rating factors are needed in the classroom instruction. • Behavioral anchors and 7-point rating scale are appropriate for the entire crew coordination program.
Grade Slips	• Aircrew Coordination Training Grade Slips followed the already familiar maneuver/procedure grade slip. • The expanded grading system (S+, S, S-, U) allows IPs to identify strengths and weaknesses without threatening crew ratings or unit readiness. • Expanded rating system, if fielded, would allow me to sleep at night.
General Observations	• Positive crew response and increased performance demonstrate that we can train crew coordination in units. • Enhances everybody's ability to perform safely. • Involve the chain of command from the start. • I could do everything I needed to do as an evaluator. • I am comfortable evaluating crews and confident that my grades are fair. • Training and evaluations covered all aspects of crew coordination and allowed me to use my own judgment as required. • My evaluations are now crew rather than individual aviator centered. • I'm already using the crew coordination concepts during missions in my unit. A multiship NVG assault mission last week was the best mission I have flown in my aviation career.

Moreover, they said that they are better evaluators and that they are evaluating crews, not individual crew members, as a result of participating in the crew coordination program. There was agreement that the course had personally made them safer and more effective aviators. The group indicated that they were planning to implement the crew coordination training locally and that the USAAVNC should provide the training on an Army-wide basis as soon as possible.

Operational Safety Implications

The following two sections discuss the potential impact of crew coordination training on aviation safety. Included in the discussion is crew coordination training impact on "marginal" crews and how testbed performance is correlated to a USASC study.

Effects of the Crew Coordination Training on Marginal Crews

ARI expressed concern about the effects of the crew coordination training program on "marginal" aviators. In the past, an assumption was made that a small percentage of aviators cause most of the human factors-related accidents. This assumption was the topic of several discussions in the USAAVNC Working Group and has been a longstanding concern of the USASC. This report does not intend to prove or disprove the assumption. However, if the assumption is true, it is of considerable interest to investigate the effects of the training on the lower performing aviators and crews. If the data show that crew coordination training has a positive influence on performance for marginal aviators (and the crews in which they operate), it is logical to conclude that the training will have a highly positive impact on flight safety.

The first step in addressing ARI's concern was to determine which crews participating in the validation testbed were marginal. An analysis was done in which the crews were rank-ordered from low to high on three variables: (1) Average Score for the 13 Basic Quality ratings, (2) Average Score for the 18 ATM Tasks, and (3) the Overall Grade for the Flight. On each of these variables, five crews ranked lowest. These crews were numbers 7, 11, 13, 14, and 15. Next, post-training data was generated on the three variables.

Review of the data showed that crew number 14 actually got worse after the training. This did not seem right. Fort

Campbell was contacted to determine if perhaps the crew was overly fatigued after flying late at night or if some other reason accounted for their poor performance. A unit IP explained to us that the pilot in command (PC) of crew number 14 was being involuntarily separated from the Army. We concluded, therefore, that it would have been better had he not participated in the testbed at all. Although we did not go back and remove that crew from the previous analyses, we did not include them in the micro-analysis of marginal crews. Thus, four crews, the lowest 25%, were examined for this analysis.

Table 18 presents the data for selected variables presented in previous sections for the four marginal crews. Variables were not included in Table 18 if there were little or no differences between pre- and post-training evaluations. In most of those cases, a "ceiling effect" existed; that is, most of the scores were very high to start with.

Table 18 shows that marginal crews markedly improved from the pre- to post-training evaluations. The following discussion focuses on only the shaded rows in the table.

IP ratings. *Mean for all 13 Basic Quality Ratings, Average Score for the 18 ATM Tasks, and Overall Grade for the Flight:* IP ratings show very high improvement across all rating scales. Because these data were generated using highly reliable measures, this result may be the most dependable measure of improved performance for the marginal crews. All three measures show that the marginal crews improved to an acceptable or satisfactory level by the time they were evaluated during the post-training mission. In fact, the average scores for the marginal crews are very similar to the average scores for the entire testbed sample.

Navigation. *Percent of Time Off Course, and Arrived at Correct LZ:* The marginal crews improved markedly in these two navigation-related mission performance measures. During the post-training evaluation, the marginal crews were on course 47% more of the time. Furthermore, only two crews arrived at the correct LZ during the pre-training ride, whereas all four crews reached the correct LZ in the post-training ride. Tactical navigation is a highly crew-coordinated activity and these crews performed quite well in this area in the post-training evaluation. Again, the crews' average score improved to a level that is quite similar to the average score for the entire testbed sample. In fact, for these two variables, the marginal crews' average was above that for all of the crews.

Table 18

Pre- and Post-training Scores for Marginal Crews

Measure	Crew #7		Crew #11		Crew #13		Crew #15		Average	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
IP RATINGS										
Mean for all 13 BQ Ratings	2.1	3.9	3.3	3.6	2.5	3.9	3.1	4.6	2.8 marginal	4.00 acceptable
Average Score for the 18 ATM Tasks	1.1	1.7	1.00	2.00	1.1	1.7	1.3	2.2	1.1 S-	1.90 S
Overall Grade for Flight	U	S	U	S-	U	S	S-	S+	U	S
NAVIGATION										
# of course deviations >500m beyond standard	2	1	5	1	3	2	4	1	3.50	1.25
% of time off course	84.6	24.7	51.7	16	61.6	8	49.9	10.5	62%	15%
Correct LZ?	not reached	Yes	No	Yes	Yes	Yes	Yes	Yes	50%	100%
Deviation in seconds of LZ arrival time	N/A	-21	62	-329	35	-17	153	-380	N/A	N/A
THREAT										
Threat Encounter Rating	2	3	3	0	threat inoperative	2	2	0	N/A	N/A
EMERGENCIES										
Detect minor malfunction	Yes	Yes	No	No	Yes	Yes	No	Yes	50%	100%

(Continued)

Measure	Crew #7		Crew #11		Crew #13		Crew #15		Average	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
INSTRUMENT RECOVERY										
% Corr Rec Steps	80	100	100	100	80	100	0	100	65%	100%
Rating of Approach Planning	Marg-inal	Supe-rior	Marg-inal	Marg-inal	Good	Good	Marg-inal	Marg-inal	1.25 Marginal	1.75 Good
# Altitude Deviations > 100′ beyond standard	0	0	2	0	0	0	2	2	1.3	.5
Properly timed inbound leg	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	75%	100%
OVERALL MEASURES										
Mission Threatening Error Rating	S-	S+	S	S+	U	S	S-	S	.75 U/S-	2.5 S/S+
Percent of mission segments accomplished	33	80	53	93	67	80	53	93	52%	87%
X FLOT & Ext Load Complete?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	75%	100%
# of crashes	0	0	0	0	0	0	0	0	0	0

N/A = Not applicable or could not calculate because of missing data.

Overall measures. *Mission Threatening Error Rating, and Percent of Mission Segments Accomplished:* All marginal crews (100%) were brought to a level of "S" or "S+" on the mission threatening error rating scale. This is better than the whole group because only 75% of those crews received an "S" or "S+" rating. For the pre-training evaluation, the marginal crews accomplished an average of only 52% of the mission segments; the group of 16 crews averaged 66%. The percent of post-training mission segments accomplished by the marginal crews (87%) was

nearly identical to, and represents a much larger gain than, the average percentage accomplished by the whole group (86%).

Relationship of Crew Coordination Training to Flight Safety

Army aviation has an unrelenting interest in safely performing its mission. Certainly, military flight operations have inherent risks, but the Army continues to upgrade its systems, doctrine, and training to mitigate risks to acceptable levels. As technology has improved, a smaller and smaller percentage of aviation accidents are caused by materiel malfunctions. As Army aircraft have become more reliable, the human factor has increasingly been cited as a causal factor in aviation accidents.

A central feature of the Army's crew coordination training is that it is designed to reduce the number of accidents. It has been noted in numerous accident investigations conducted by civil and military agencies that the ability to prevent, or the information needed to avoid an accident is often available in the cockpit. In these instances, mismanagement of resources and a lack of coordinated activities led to disaster. Most of the time, when human factors is a primary or significant contributor to an accident, it is not one miscalculation or one mistake that leads to trouble; instead, it is a series of errors. In the training course, the chain of human factor events leading to an accident is called the error chain.

Breaking an error chain before it becomes critical is paramount to safe flight. Certain crew actions can be implemented to break the error chain. These actions, or crew coordination management activities required to break an error chain, avoid accidents, and effectively perform as an aircrew are called the Crew Coordination Objectives in the training provided to aviators. The Crew Coordination Objectives, as taught in the course, are completely defined by the aircrew coordination Basic Qualities, the ATM Aircrew Coordination Elements, and the ATM Tasks.

In a 1991 study, the USASC (Owens, Robertson, Thill, & Zeller, 1991) identified a number of recurring task errors committed by crew members who were involved in over 400 aviation accidents occurring between FY84-89. All of the task errors mentioned in the USASC report are addressed in the crew coordination training and evaluated using the Basic Quality ratings and ATM Task grades. Descriptions of these task errors

and their frequency of occurrence in the accident cases are shown in Table 19.

Table 19

Human Error Patterns in Army Aviation Accidents (from Owens et al., 1991)

Task error	Percentage of accidents[a]
Improper monitoring or scanning	45%
Improper decision or selection of course of action	36%
Improper control action or task completion	24%
Inadequate inspection or checking of SOPs, ATMs	12%
Inadequate communication of information	11%
Misjudge clearance, speed, weight, size, distance, time	9%
Inadequate planning and task organization	7%
Failure to recognize or identify critical condition	6%
Failure to anticipate upcoming events	6%
Misinterpretation of communication, cue, or condition	3%
Inadequate improvising, troubleshooting, problem solving	1%

[a]Percentages do not add up to 100% because more than one type of task error can be involved in a given accident.

Many of the task errors in Table 19 were committed during the execution of ATM Tasks similar to those performed during the testbed missions. Four of the 18 ATM Tasks involved in the testbed were the exact same tasks noted in the USASC accident analysis. A fifth task, ATM Task 1071 (Perform as a Crew Member) is no longer an ATM Task in the current revision of TC 1-212 because crew coordination is now embedded in all ATM Tasks.

Table 20 shows the five ATM Tasks that appeared in both the USASC analysis and the validation testbed scenarios.

Table 20

Frequently Violated ATM Procedures Evaluated in the Testbed

	ATM Task # and description	Average percentage[a]
1035/2081	Terrain Flight	31%
1071	Perform as a Crew Member	10%
1083	Inadvertent IMC/VHIRP	9%
1028	VMC Approach	6%
2016	External Load Operations	3%

[a]Average percentage value based on frequency of occurrence, total accident cost, number of fatalities, and number of injuries.

To analyze improvements due to the testbed, the average score on all ATM Tasks was substituted for ATM Task 1071, Perform as a Crew Member, because (1) aviators were being evaluated as crews and not as individuals and (2) crew coordination considerations are embedded in all ATM Tasks. With this substitution, Table 21 shows the change in performance between the pre- and post-training evaluations for each of the above listed frequently violated ATM tasks.

Performance improved across all five tasks, with three (2081/79, 2016, and the 18 Tasks) of the five grades showing significant change after the training. After the training, performance was Satisfactory for all Tasks. ATM Task performance can be considered the "last link" in the error chain.

Breaking the chain at the final point is certainly important, but aviation error chains usually begin long before an ATM Task is performed. As discussed earlier, the USAAVNC Working Group divided crew coordination behaviors into micro- and macro-level behaviors. The micro-level behaviors are trained and evaluated through the ATM Tasks. Macro-level behaviors are trained and evaluated through the Crew Coordination Objectives as defined by the 13 Basic Qualities. In terms of flight safety and

Table 21

Pre-training to Post-training Change in Performance[a] for Frequently Violated ATM Procedures

	UH-60 ATM Task	Pre-training		Post-training
2081	Terrain Flight[b]			
2079	Terrain Flight Navigation[b]	1.4	**	2.0
Average Score for the 18 Tasks		1.4	**	1.9
1083	Inadvertent IMC/VHIRP	1.8		2.1
1028	VMC Approach	1.9		2.0
2016	External Load Operations	1.4	**	2.0

[a]ATM Task Performance graded on a S+, S, S-, U (3, 2, 1,0) scale.
[b]An average score for ATM Tasks 2081 and 2079 was used. Also, the numbering and organization of the new ATM changed so that these two tasks were the same as 1035/2081 in the USASC study.
**$p < .01$.

the error chain, ATM Task performance improvement addresses the final link in the error chain; however, the Crew Coordination Objectives and Basic Qualities address the earlier links in the error chain.

To understand how the crew coordination training correlates with the USASC accident data, an analysis was done to correlate the 11 USASC task errors (Table 19) with the 5 Crew Coordination Objectives. The first step in this analysis involved inspecting the overlap between each USASC task error and the Crew Coordination Objectives. For instance, improper monitoring or scanning errors relate directly to team relationships, exchanging mission information, and cross-monitoring performance. In this manner, all the USASC task errors were correlated with the Crew Coordination Objectives. Table 22 shows the relationship between the USASC task errors and the Crew Coordination Objectives. Note that every task error is addressed by at least one of the training objectives and, in most cases, is covered by two or more

training objectives. Instruction that is designed to deal with recurring errors will reduce the incidence of those errors and should have a positive effect on flight safety.

The bottom row of Table 22 shows the average score for the Basic Qualities composing each of the Crew Coordination Objectives for the pre- and post-training evaluations. As can be seen in this bottom row, the improved performance for each of the Crew Coordination Objectives is significant. For each objective, performance improves from "marginal" to "acceptable" or better. Presumably the margin of safety will be improved likewise.

The same types of error chains and task errors committed by crews involved in the USASC study were also committed by the testbed aircrews. Because the mission was simulator based, no injuries occurred. Several errors observed during the testbed were considered critical because of their potential impact on flight safety. Table 23 shows these errors and the differences in their occurrence from the pre- and post-training evaluations.

There were significant reductions in the occurrence of the five critical errors shown in Table 23 between the pre- and post-training evaluations. In two cases, the errors were completely eliminated; in the other three, substantial reductions in occurrence were achieved.

Although this improvement in performance may not translate directly to an equal percentage reduction in accidents and loss of life and property, there is adequate evidence to support the premise that flight safety is enhanced as a result of the training provided during the testbed. For instance, the magnitude of the improvements in safety-related actions is similar to those seen in the mission performance enhancements. Because accidents are usually caused by a series of errors (error chain) and not just a single error, these improvements should result in similar reductions in errors committed during flight and a corresponding decrease in the overall number of accidents. The evidence suggests that crew coordination training significantly reduces the likelihood of occurrence of the type of errors that the USASC has shown to be major contributing factors to previous accidents.

Table 22

Relationships Between the USASC Task Errors and USAAVNC Crew Coordination Objectives

Crew Coordination Objectives / USASC Task Errors	Establish and maintain team relation-ships	Mission planning and rehearsal	Establish and maintain workload levels	Exchange mission information	Cross-monitor performance
Improper monitoring or scanning	✓			✓	✓
Improper decision or selection of course of action	✓	✓		✓	✓
Improper control action or task completion			✓	✓	✓
Inadequate inspection or checking of SOPs, ATMs	✓	✓			✓
Inadequate communication of information	✓			✓	✓
Misjudge clearance, speed, weight, size, distance, time				✓	✓
Inadequate planning and task organization	✓	✓	✓		✓
Failure to recognize or identify critical condition				✓	✓
Failure to anticipate upcoming events		✓	✓		✓
Misinterpretation of communication, cue, or condition		✓			

(Continued)

Crew Coordination Objectives / USASC Task Erors	Establish and maintain team relation-ships	Mission planning and rehearsal	Establish and maintain workload levels	Exchange mission information	Cross-monitor performance
Inadequate improvising, troubleshooting, problem solving	✓		✓	✓	✓
Pre- and Post-Training Scores for each Crew Coordination Objective[a]	Pre → Post 3.4 → 4.6	Pre → Post 3.1 → 4.6	Pre → Post 3.2 → 4.3	Pre → Post 3.1 → 4.2	Pre → Post 3.2 → 4.1

[a]Scores were determined by calculating the average grade for the Basic Qualities composing each Crew Coordination Objective. The Basic Qualities were rated on a seven-point scale with 1 = Very Poor, 2 = Poor, 3 = Marginal, 4 = Acceptable, 5 = Good, 6 = Very Good, and 7 = Superior.

Recommendations for Fielding the Crew Coordination Training and Evaluation Packages

The crew coordination training and evaluation system tested at Fort Campbell was very effective. The data collected show that the crew coordination training and evaluation system improves attitudes, positively affects behavior, enhances mission performance, and increases the margin of safety. In addition, the instructors and aviators who participated in the testbed attested to the advantages and worthiness of the program.

The results reported in this paper have been presented to the USAAVNC and coordinated at higher levels in the Army. Thus, there are a number of actions that are being undertaken.

1. The USAAVNC is beginning to incorporate the training into the schoolhouse training for the IERW and various aviator qualification courses (AQC).

Table 23

Measured Improvement in Safety Performance

Testbed mission error	Pre-training	Post-training	Reduction in error
Number of crews failing to detect system malfunctions	6	0	100%
Number of aircraft crashes due to crews failing to maintain terrain and obstacle clearance during terrain flight	7	4	43%
Number of crews not successfully transitioning from VMC to IMC flight	2	0	100%
Number of crews violating altitude standards (>±100') during instrument recovery	7	2	71%
Number of crew violating minimum altitude restrictions during nonprecision approach	6	1	83%

2. A USAAVNC team of IPs is being assembled within the Aviation Training Brigade to install this training at each Army simulator facility in the CONUS, Europe, and Korea over the next two years. The team will train the facility IPs.

3. Video recording equipment is being purchased and installed in each of the Army's flight simulators.

4. Reserve and National Guard forces will receive identical training through their simulator facilities at the Eastern Army Aviation Training School and the Western Army Aviation Training School.

5. The training will be passed down to the Army's operational units as each unit rotates through one of the simulator facilities for their normal training cycle.

6. The ARIRWARU, working with the USAAVNC/DES, will conduct a follow-on evaluation of aviator proficiency to determine the frequency of required recurrent training.

7. The Chief of Staff of the Army has asked the Training and Doctrine Command (with technical assistance from the ARIRWARU) to explore the applicability of the USAAVNC crew coordination training to other crew-served weapon systems in the Army.

The testbed provided a number of lessons learned for the project staff and the USAAVNC Working Group. Many of the lessons learned at Fort Campbell have been incorporated into revisions of the training and evaluation materials recently submitted to the ARI (Grubb et al., 1992; Pawlik et al., 1992). The process used to develop the materials is discussed in companion volumes (Grubb et al., in preparation; Pawlik et al., in preparation). Those volumes also describe the products and make recommendations specific to the evaluation or training materials. Most of those specific recommendations are not repeated here. Only recommendations that have broader implications for the crew coordination project are included in this section. Following is a list of project recommendations and a short rationale for each.

1. The primary recommendation stemming from this project is to deploy the crew coordination training and evaluation system. The program has significant military worth and highly desirable aviation safety ramifications. The new ATMs, by themselves, do not provide sufficient detail to implement the crew coordination training and evaluation program.

2. The exportable training and evaluation packages (Pawlik et al., 1992; Grubb et al., 1992) should only be implemented in units having IPs certified as having completed Army Aircrew Coordination Instructor Training. To be certified, instructors should be qualified IPs who have (a) completed the 51-hour Instructor Course, and (b) taught and evaluated the student course under the supervision of a USAAVNC Trainer.

3. The USASC and USAAVNC should set up a system whereby ATM Tasks that are causing safety or performance problems are identified and transmitted to the field. Unit Instructor Pilots should be given this information. It was observed that the testbed data showed when IPs focus on selected ATM Tasks crew performance on those tasks improves significantly.

4. The Army should not view crew coordination training as a one-time train-up effort. Reinforcement of training is important--practice and currency are keys to its effective use. The USAAVNC should provide guidance to the field on methods and techniques to develop crew coordination continuation and refresher training.

5. Training of "high-risk/low-performer" aviators or crews should be implemented as soon as possible. The improvement in mission performance and flight safety for low-performing crews will be dramatic. High risk aviators can be easily identified through unit IPs. The ease with which IPs can identify problematic aviators or crews was shown during the 1990 testbed. The dramatically improved performance for low-performing crews was shown in the 1992 testbed.

6. An executive summary of the program and its benefits should be written for senior Army management. The summary could take the form of a short written synopsis, briefing charts, posters, a videotape, or a combination of the four media. It should "sell" the program. The program requires a considerable resource and cultural commitment from all levels of aviation commanders. An executive summary of the program and its benefits would encourage support from the people who will make resource decisions and provide them with information they need to make the commitment.

7. Concentrate on training crew coordination behaviors through the use of the Basic Qualities (macro-level behaviors) and the ATM Tasks (micro-level behaviors). Crew members can learn and IPs can evaluate both types of behaviors. Furthermore, the testbed participants told us that they appreciated getting all the information; they preferred a more intellectually stimulating course instead of being "spoon fed" the material on only a basic level.

8. Increase the use of flight simulators to practice tactical missions based on the unit Mission Essential Task List (METL). Aviators from both the 1990 and 1992 testbeds commented that they found tactical missions in the simulator to be challenging and instructive. To implement this recommendation, unit instructors will need to have in-depth training on scenario development.

9. The USAAVNC should conduct a follow-on evaluation of crew proficiency to determine the frequency of required recurrent training.

Recommendations for Future Research

The crew coordination training and evaluation program discussed in this report, although successful, needs to be considered in other contexts. A number of areas, discussed below, would benefit from future research and development of the program.

1. The crew coordination material needs to be tested in the AH-64, CH-47, UH-1, and OH-58 fleets. The material delivered to the Army has been tested only with the UH-60. Each Army aircraft is built and flown differently and duties and responsibilities in the cockpit are different. In addition, several of the Army's aircraft have nonrated crew aboard. Although the project staff believes that the material delivered to the Army is broadly applicable to other aircraft, this belief has not been substantiated.

2. The crew coordination material needs to be revised and tested for aircraft without simulators or for units that do not have easy access to high fidelity simulators. Videotaping is an integral part of the crew coordination training and evaluation system that was recently delivered to the Army. Although videotaping in a flight simulator presented minor technical problems that were easily solved in the current program, videotaping aboard an actual aircraft is a technical problem that this project did not address. Obtaining airworthiness certification for on-board videotape equipment could be a major endeavor.

3. The interactive effects of battle-rostering and crew coordination training need to be assessed. Both of these concepts are being deployed in the 1992 and 1993 revisions to all Army aircraft training circulars, but battle-rostering and crew coordination are not synonymous. Moreover, the crew coordination training has not been designed to specifically address the pros and cons of battle-rostering. For instance, we do not know whether complacency becomes a factor in battle-rostering, or how often battle-rostered crews should fly together.

4. An automated method is needed to collect statistics on the crew coordination performance level for each participating crew member and unit. Software needs to be developed to accommodate this need. If the USAAVNC does not develop the software, each aviation unit will have to do so or forgo the benefits of tracking unit statistics. Units need to know how well aviators, crews, and units are performing mission essential tasks. Units also need to know what tasks are causing problems and how well they are performing ATM Tasks in comparison to other units. An automated tracking system that will operate on widely available microcomputers should be developed.

5. The training and evaluation packages (Pawlik et al., 1992; & Grubb et al., 1992) need to become an integrated package. The reason that separate packages were developed, one for evaluation and one for training, was largely due to the contractual process. First, DRC was on contract to develop the field exportable evaluation system; later, we were on contract for the crew coordination training system. The result was that each area had separate sets of deliverable products. The products were, however, developed by the same team and use the same notions of crew coordination. Thus, it would be feasible to make the two packages into one integrated, less complex package.

6. Crew coordination skills would be useful for cross-platform coordination activities. Army aircraft often fly missions in conjunction with one or more other aircraft. These other aircraft may include similar types of aircraft or they may be aircraft that perform symbiotic functions wherein extensive cross-platform coordination must be implemented; e.g., the OH-58 and the AH-64. The crew coordination training and evaluation system as currently designed is for intra-aircraft activities. It would be useful to take the same team-related concepts used in crew coordination and extend them to a larger team.

7. Much of the material used in the aircrew coordination training and evaluation needs to be transitioned to other crew-served weapon systems, such as tracked vehicles, command and control centers, artillery systems, etc. The program addressed in the ARI's current research program involves only aircrew coordination; however, its coordination concepts, principles, and skills would be the same for other crew systems; only the environment would be different. Because the current program has proven to be highly effective, it is likely that other weapon systems would benefit as well.

8. The crew coordination materials need to be integrated into the IERW course. The current program has been developed for use by operational units. The problem of how to best integrate crew coordination into IERW has not been studied. Several difficulties are inherent to placing crew coordination training into IERW. First, IERW students are primarily concerned with learning the science of flying and controlling the aircraft. The concepts and higher order cognitive skills contained in the crew coordination training are unlikely to be well learned by the IERW students who are preoccupied with learning things of seemingly more immediate concern. Also, little time is available in IERW. The crew coordination training program requires 18 classroom hours and several simulator missions. We have not studied the problem of what might be eliminated from the crew coordination program to fit into the IERW's very demanding and compressed schedule. After going through a very deliberate development process, project staff cannot determine what the USAAVNC might want to drop because (a) all of the material currently in the program has been deemed necessary by the USAAVNC, and (b) the validation testbed shows that the program works well. A third difficulty is that IERW students will have problems practicing crew coordination skills because most of their flight time is with an IP flying in the other pilot's seat of the aircraft. Although the training material urges IPs in this position to role play as another pilot, the IERW situation practically precludes role playing for an IP; IPs need to instruct.

9. A study needs to be undertaken to address the issue of how crew coordination will be introduced or integrated in the USAAVNC resident courses. Examples of career courses in which crew coordination should be introduced include the Aviation Officer Basic and Advanced, and the Aviation Senior Warrant Officer Training courses. Examples of technical courses in which crew coordination should be integrated include the Initial Entry Rotary Wing Aviator, Aircraft Qualification, Instructor Pilot, Rotary Wing Refresher, and Helicopter Repairer courses. Senior-level courses, such as the Aviation Pre-Command Course, should also be given an introduction to the aircrew coordination training program. If crew coordination training is going to work well for the Army, then it must be given at all levels. Crew coordination training will not work in isolation; it must be supported and encouraged by aviation commanders, instructors, and crew members. The recommended study should help the USAAVNC determine what aspects of the Aircrew Coordination Course receive

emphasis within each of the resident courses. Subsequent to this determination, relevant training material should be developed for inclusion in each of the courses.

10. A study should be pursued to determine the effectiveness of using the expanded (S+, S, S-, U) grading system employed in the testbed. IPs from the Fort Campbell testbed liked this grading system for several very good reasons such as, "Yeah, it would help me sleep at night." From a psychometric point of view, IPs are clearly capable of grading ATM Tasks on a four-point scale, are comfortable doing it, and more information is obtained in this manner. The USAAVNC, on the other hand, feels that adequate information is gathered via the current S or U grading system.

Summary and Conclusion

The ARIRWARU sponsored a very successful research program during 1992. They worked closely with the USAAVNC to deploy the products of its multiyear research program to Army aviation's operational community. The crew coordination training and evaluation program as tested and delivered to the Army can significantly improve mission effectiveness and enhance the margin of aviation safety. However, more work needs to be done. The current work primarily involves deploying the training and tailoring it to fit the unique requirements of the Army's various aviation fleets. ARIRWARU has developed and delivered a program that works well. However, their role in fielding the crew coordination training and evaluation system will diminish because much of the work to be done is no longer considered to be research and development and is, therefore, outside of ARIRWARU's mission.

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Appendix A

Army Aviation Crewmember Questionnaire

and

Frequency Tables

Appendix A-1

Army Aviation Crewmember Questionnaire

Instructions

The US Army Aviation Center (USAAVNC) and the US Army Research Institute (ARI) are researching the area of crew coordination in Army Aviation. The goal of this research is to improve performance and increase the margin of safety on an Army-wide basis. Previous research by other DoD services and commercial aviation into the area of crew coordination has contributed to substantial gains in both performance and safety.

Because Army Aviation is unique, much of the information discovered by the other services and the commercial world is not directly applicable to the Army Aviation environment. Consequently, the USAAVNC-ARI research program is designed to meet the specific needs of Army aviation. As a result of this approach, the following actions are now ongoing or planned: Mission simulations are being developed to stress aircrew-type tasks, enhanced aircrew coordination training is being developed, the US Army Safety Center is incorporating crew factors into the accident investigation process, Aircrew Training Manuals and the annual proficiency and readiness test program are being revised, and revisions to readiness reporting are being planned.

This Army Aviation Crewmember Questionnaire has been developed as part of the USAAVNC-ARI research program to obtain your opinion about crew operations. As an Army aviator, your participation is essential to the program's success. Your opinions are important and will be used to guide the next phase of the research program.

The questionnaire should take approximately 20 minutes to complete. The first page of the questionnaire asks you for background information -- please try to be accurate. The next three pages contain 46 statements for which there are no "right" or "wrong" answers. We are simply asking for your honest opinion to each statement. Please consider each statement carefully.

THANK YOU FOR YOUR PARTICIPATION.

IMPORTANT

The information you provide in this questionnaire is confidential and will be used for research purposes only. Your answers will neither be attributed to you personally nor become a part of any personnel or aviation record kept on you.

Army Aviation Crewmember Questionnaire

I. Background Information

(Please complete the following information regarding your personal experiences and current status.)

1. Aviation Experience:

	Lifetime Flying Experience		Experience over last 6 months	
	All Conditions	NV Devices (e.g., NVG)	All Conditions	NV Devices (e.g., NVG)
a. Primary acft hrs.	_____	_____	_____	_____
b. R/W hrs.	_____	_____	_____	_____
c. Fixed Wing hrs.	_____	_____	_____	_____

2. Primary Aircraft _____ *(Fill in aircraft designation)*
3. Current Rank _____
4. Current Unit (Co/Bn/Rgt) _____
5. Time in Current Unit (months) _____
6. Current Aviator Readiness Level (RL) 1 2 3 *(circle one number)*
7. Current Crew Readiness Level (CRL) 1 2 *(circle one number)*
8. Current primary duty assignment in unit *(check one)*:

   PC*___ PI ___ CP ___ CPG ___ CE/FE ___ AO/AFSO/TO___ OR*___

   **Note: PC includes IP, SP, IE, UT, ME, MP duty positions; OR includes gunner and flight medic.*
9. Are you flight lead qualified *(circle one)*: Yes No
10. Have you had Aircrew Coordination Training? Y or N *(circle one: if yes, answer below.)*

    Describe ACT training experiences: Course title, location of training, approximate date, # of hours of instruction, quality of course.

    a. Experience #1: _____

    _____

    b. Experience #2: _____

    _____
11. Cross-indexing Code (*Note*: Because the results of this questionnaire will be correlated with other measures, a social security number is required.)

Social Security #: _____ Today's Date _____
(day/mo/yr)

II. Opinion Survey

(Please circle the number on the agree-disagree dimension that best reflects your personal attitude toward each statement. There are no "right" or "wrong" answers. We are simply asking for your honest opinions.)

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1.	**Crewmembers should feel obligated to mention their own psychological stress or physical problems to other crewmembers before or during a mission.**	1	2	3	4	5	6	7
2.	**Crewmembers should monitor each other for signs of stress or fatigue and should discuss the situation with the affected crewmember(s).**	1	2	3	4	5	6	7
3.	**Good communication and crew coordination are as important as technical proficiency for the safety of the flight.**	1	2	3	4	5	6	7
4.	**Crewmembers should be aware of and sensitive to the personal problems of other crewmembers.**	1	2	3	4	5	6	7
5.	**The pilot flying the aircraft should verbalize plans for procedures or maneuvers and should be sure that the information is understood and acknowledged by affected crewmembers.**	1	2	3	4	5	6	7
6.	**Even when fatigued, I perform effectively during most critical flight maneuvers.**	1	2	3	4	5	6	7
7.	**Pilots-in-command should encourage pilots and crew chiefs to question procedures and flight profile deviations during normal flight operations and in emergencies.**	1	2	3	4	5	6	7
8.	**There are no circumstances where the pilot should take the aircraft controls without being directed to do so by the pilot-in-command.**	1	2	3	4	5	6	7
9.	**A debriefing and after action review of procedures and decisions after each mission are important for developing and maintaining effective crew coordination.**	1	2	3	4	5	6	7
10.	**Crew coordination is more important under high stress conditions than it is under low stress conditions.**	1	2	3	4	5	6	7
11.	**Effective crew coordination requires crewmembers to take into account the personalities of other crewmembers.**	1	2	3	4	5	6	7

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
12. The pilot-in-command's responsibilities include coordinating inflight crew chief activities.	1	2	3	4	5	6	7
13. Most crewmembers are able to leave personal problems behind when flying a mission.	1	2	3	4	5	6	7
14. My decision making ability is as good in emergencies as it is in routine mission situations.	1	2	3	4	5	6	7
15. The pilot-in-command is solely responsible for leadership of the crew team.	1	2	3	4	5	6	7
16. Pilots should consider crew chief questions and suggestions.	1	2	3	4	5	6	7
17. When joining a unit, a new crewmember should not offer suggestions or opinions unless asked.	1	2	3	4	5	6	7
18. Because crew chiefs have no pilot training, they should limit their attention to their formally defined crew chief duties.	1	2	3	4	5	6	7
19. Pilots-in-command who accept and implement suggestions from the crew lessen their stature and reduce their authority.	1	2	3	4	5	6	7
20. Crewmembers should monitor the pilot-in-command's performance for possible mistakes and errors.	1	2	3	4	5	6	7
21. The best way to correct an error is to alert the error maker so that he can correct the problem.	1	2	3	4	5	6	7
22. Crewmembers' errors and mistakes during the mission, including the pilot-in-command's mistakes, should be a significant part of post flight crew discussions.	1	2	3	4	5	6	7
23. The pilot-in-command should seek advice from crewmembers when updating mission plans.	1	2	3	4	5	6	7
24. The pilot-in-command should use his crew to help him maintain situation awareness.	1	2	3	4	5	6	7
25. The pilot-in-command is solely responsible for maintaining awareness of crew capabilities.	1	2	3	4	5	6	7
26. Only when the pilot-in-command is overloaded should he pass workload to other crewmembers.	1	2	3	4	5	6	7
27. Crewmembers should be aware of other crewmembers' workload.	1	2	3	4	5	6	7

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
28. If a crewmember is having difficulties executing his responsibilities, other crewmembers should provide assistance.	1	2	3	4	5	6	7
29. Highly competent pilots do not experience task overload.	1	2	3	4	5	6	7
30. A crewmember should offer task help to another crewmember only if he is sure the crewmember needs it.	1	2	3	4	5	6	7
31. The pilot-in-command should not get involved with the execution of responsibilities assigned to other crewmembers.	1	2	3	4	5	6	7
32. Crewmember task overload usually occurs because the crewmember is not very competent.	1	2	3	4	5	6	7
33. Pilots-in-command should employ the same style of leadership in all situations and with all crewmembers.	1	2	3	4	5	6	7
34. Pilot-in-command instructions to other crewmembers should be general and non-specific so that each individual can practice self-management and can develop individual skills.	1	2	3	4	5	6	7
35. A relaxed attitude is essential for maintaining a cooperative and harmonious cockpit.	1	2	3	4	5	6	7
36. Reprimands are more effective than discussions in eliminating a crewmember's poor flying habit.	1	2	3	4	5	6	7
37. Nonrated crewmembers should be actively involved in planning the mission.	1	2	3	4	5	6	7
38. Understanding the commander's concept is of minor importance to mission execution.	1	2	3	4	5	6	7
39. Each crewmember should watch for situations in which external events limit others' performance.	1	2	3	4	5	6	7
40. Thinking through difficult segments, events, and tasks is primarily the pilot-in-command's responsibility.	1	2	3	4	5	6	7
41. My knowledge of unit SOP and aircraft emergency procedures makes rehearsing familiar missions unnecessary.	1	2	3	4	5	6	7
42. An essential element of premission planning is discussing crew responsibilities and required actions for abnormal events.	1	2	3	4	5	6	7
43. Recent events in my personal life have little to do with my performance as a crewmember.	1	2	3	4	5	6	7

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
44. Crewmembers should be able to anticipate requirements as the mission progresses.	1	2	3	4	5	6	7
45. My individual performance is as good in degraded systems conditions as it is in a "full up" aircraft.	1	2	3	4	5	6	7
46. External circumstances require crewmembers to provide situational leadership for short periods of time.	1	2	3	4	5	6	7

APPENDIX A-2

ARMY AVIATION CREWMEMBER QUESTIONNAIRE FREQUENCY TABLES

C1 Crewmembers should feel obligated to mention their own psychological stress or physical problems to other crewmembers before or during a mission.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	5	15.6
Agree	6	16	50.0
Strongly Agree	7	11	34.4
	Total	32	100.0

Mean 6.188 Std dev .693 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Agree	5	2	6.3
Agree	6	18	56.3
Strongly Agree	7	12	34.4
	Total	33	100.0

Mean 6.156 Std dev .954 Valid cases 32

C2 Crewmembers should monitor each other for signs of stress or fatigue and should discuss the situation with the affected crewmember(s).

Pretraining Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Agree	6	17	53.1
Strongly Agree	7	14	43.8
	Total	32	100.0

Mean 6.375 Std dev .660 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	1	3.1
Agree	6	18	56.3
Strongly Agree	7	13	40.6
	Total	32	100.0

Mean 6.375 Std dev .554 Valid cases 32

C3 Good communication and crew coordination are as important as technical proficiency for the safety of the flight.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Disagree	3	1	3.1
Slightly Agree	5	1	3.1
Agree	6	11	34.4
Strongly Agree	7	19	59.4
	Total	32	100.0

Mean 6.469 Std dev .842 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Agree	6	10	31.3
Strongly Agree	7	22	68.8
	Total	32	100.0

Mean 6.688 Std dev .471 Valid cases 32

- -

C4 Crewmembers should be aware of and sensitive to the personal problems of other crewmembers.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	7	21.9
Agree	6	17	53.1
Strongly Agree	7	5	15.6
	Total	32	100.0

Mean 5.688 Std dev 1.03 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Neutral	4	1	3.1
Slightly Agree	5	4	12.5
Agree	6	18	56.3
Strongly Agree	7	8	25.0
	Total	32	100.0

Mean 5.938 Std dev 1.01 Valid cases 32

C5 The pilot flying the aircraft should verbalize plans for procedures or maneuvers and should be sure that the information is understood and acknowledged by affected crewmembers.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	15	46.9
Strongly Agree	7	15	46.9
	Total	32	100.0

Mean	6.406	Std dev	.615	Valid cases	32

Post-training Results:

Response	Value	Frequency	Percent
Agree	6	17	53.1
Strongly Agree	7	15	46.9
	Total	32	100.0

Mean	6.469	Std dev	.507	Valid cases	32

- -

C6 Even when fatigued, I perform effectively during most critical flight maneuvers.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Disagree	3	8	25.0
Neutral	4	2	6.3
Slightly Agree	5	12	37.5
Agree	6	9	28.1
	Total	32	100.0

Mean	4.625	Std dev	1.23	Valid cases	32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	9	28.1
Slightly Disagree	3	5	15.6
Neutral	4	6	18.8
Slightly Agree	5	8	25.0
Agree	6	3	9.4
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean	3.813	Std dev	1.49	Valid cases	32

C7 Pilots-in-command should encourage pilots and crew chiefs to question procedures and flight profile deviations during normal flight operations and in emergencies.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	1	3.1
Slightly Disagree	3	4	12.5
Neutral	4	1	3.1
Slightly Agree	5	2	6.3
Agree	6	13	40.6
Strongly Agree	7	10	31.3
	Total	32	100.0

Mean 5.531 Std dev 1.66 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	9	28.1
Agree	6	16	50.0
Strongly Agree	7	3	9.4
	Total	32	100.0

Mean 5.406 Std dev 1.26 Valid cases 32

- -

C8 There are no circumstances where the pilot should take the aircraft controls without being directed to do so by the pilot-in-command.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	15	46.9
Disagree	2	11	34.4
Slightly Disagree	3	4	12.5
Slightly Agree	5	1	3.1
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 1.906 Std dev 1.30 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	15	46.9
Disagree	2	16	50.0
Slightly Disagree	3	1	3.1
	Total	32	100.0

Mean 1.563 Std dev .564 Valid cases 32

- -

C9 A debriefing and after action review of procedures and decisions after each mission are important for developing and maintaining effective crew coordination.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	18	56.3
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 6.313 Std dev .592 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	1	3.1
Agree	6	13	40.6
Strongly Agree	7	18	56.3
	Total	32	100.0

Mean 6.531 Std dev .567 Valid cases 32

- -

C10 Crew coordination is more important under high stress conditions than it is under low stress conditions.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	2	6.3
Slightly Disagree	3	3	9.4
Neutral	4	2	6.3
Slightly Agree	5	5	15.6
Agree	6	8	25.0
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 5.563 Std dev 1.58 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	4	12.5
Slightly Disagree	3	2	6.3
Neutral	4	3	9.4
Slightly Agree	5	6	18.8
Agree	6	9	28.1
Strongly Agree	7	7	21.9
	Total	32	100.0

Mean 5.000 Std dev 1.79 Valid cases 32

- -

C11 Effective crew coordination requires crewmembers to take into account the personalities of other crewmembers.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Disagree	3	1	3.1
Neutral	4	3	9.4
Slightly Agree	5	6	18.8
Agree	6	14	43.8
Strongly Agree	7	7	21.9
	Total	32	100.0

Mean 5.625 Std dev 1.21 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	5	15.6
Agree	6	22	68.8
Strongly Agree	7	4	12.5
	Total	32	100.0

Mean 5.906 Std dev .641 Valid cases 32

C12 The pilot-in-command's responsibilities include coordinating inflight crew chief activities.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Disagree	3	1	3.1
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Agree	6	19	59.4
Strongly Agree	7	8	25.0
	Total	32	100.0

Mean 6.000 Std dev .880 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	3	9.4
Agree	6	20	62.5
Strongly Agree	7	6	18.8
	Total	32	100.0

Mean 5.875 Std dev .907 Valid cases 32

- -

C13 Most crewmembers are able to leave personal problems behind when flying a mission.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	4	12.5
Slightly Disagree	3	3	9.4
Neutral	4	10	31.3
Slightly Agree	5	3	9.4
Agree	6	10	31.3
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 4.375 Std dev 1.56 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	2	6.3
Disagree	2	7	21.9
Slightly Disagree	3	8	25.0
Neutral	4	4	12.5
Slightly Agree	5	5	15.6
Agree	6	6	18.8
Total		32	100.0

Mean 3.656 Std dev 1.59 Valid cases 32

- -

C14 My decision making ability is as good in emergencies as it is in routine mission situations.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Disagree	3	5	15.6
Neutral	4	6	18.8
Slightly Agree	5	3	9.4
Agree	6	12	37.5
Strongly Agree	7	5	15.6
Total		32	100.0

Mean 5.094 Std dev 1.46 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	4	12.5
Slightly Disagree	3	3	9.4
Neutral	4	3	9.4
Slightly Agree	5	3	9.4
Agree	6	16	50.0
Strongly Agree	7	3	9.4
Total		32	100.0

Mean 5.031 Std dev 1.59 Valid cases 32

C15 The pilot-in-command is solely responsible for leadership of the crew team.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	3	9.4
Disagree	2	7	21.9
Slightly Disagree	3	7	21.9
Slightly Agree	5	4	12.5
Agree	6	7	21.9
Strongly Agree	7	4	12.5
	Total	32	100.0

Mean 4.000 Std dev 2.04 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	7	21.9
Slightly Disagree	3	4	12.5
Neutral	4	2	6.3
Slightly Agree	5	5	15.6
Agree	6	7	21.9
Strongly Agree	7	2	6.3
	Total	32	100.0

Mean 3.750 Std dev 2.01 Valid cases 32

- -

C16 Pilots should consider crew chief questions and suggestions.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	1	3.1
Agree	6	14	43.8
Strongly Agree	7	17	53.1
	Total	32	100.0

Mean 6.500 Std dev .568 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Agree	5	1	3.1
Agree	6	18	56.3
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 6.219 Std dev .941 Valid cases 32

C17 When joining a unit, a new crewmember should not offer suggestions or opinions unless asked.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	10	31.3
Disagree	2	14	43.8
Slightly Disagree	3	2	6.3
Neutral	4	4	12.5
Slightly Agree	5	1	3.1
Agree	6	1	3.1
	Total	32	100.0

Mean 2.219 Std dev 1.28 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	20	62.5
Slightly Disagree	3	3	9.4
Neutral	4	1	3.1
Slightly Agree	5	2	6.3
	Total	32	100.0

Mean 2.156 Std dev .987 Valid cases 32

- -

C18 Because crew chiefs have no pilot training, they should limit their attention to their formally defined crew chief duties.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	8	25.0
Disagree	2	13	40.6
Slightly Disagree	3	7	21.9
Slightly Agree	5	3	9.4
Agree	6	1	3.1
	Total	32	100.0

Mean 2.375 Std dev 1.31 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	16	50.0
Slightly Disagree	3	6	18.8
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
	Total	32	100.0

Mean 2.344 Std dev 1.12 Valid cases 32

C19 Pilots-in-command who accept and implement suggestions from the crew lessen their stature and reduce their authority.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	17	53.1
Disagree	2	11	34.4
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
Agree	6	1	3.1
	Total	32	100.0

Mean 1.750 Std dev 1.13 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	14	43.8
Disagree	2	18	56.3
	Total	32	100.0

Mean 1.563 Std dev .504 Valid cases 32

C20 Crewmembers should monitor the pilot-in-command's performance for possible mistakes and errors.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Disagree	3	2	6.3
Neutral	4	3	9.4
Slightly Agree	5	6	18.8
Agree	6	14	43.8
Strongly Agree	7	7	21.9
	Total	32	100.0

Mean 5.656 Std dev 1.12 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Agree	6	22	68.8
Strongly Agree	7	6	18.8
	Total	32	100.0

Mean 6.031 Std dev .647 Valid cases 32

C21 The best way to correct an error is to alert the error maker so that he can correct the problem.

Pretraining Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Agree	6	18	56.3
Strongly Agree	7	10	31.3
	Total	32	100.0

Mean 6.156 Std dev .723 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	20	62.5
Strongly Agree	7	10	31.3
	Total	32	100.0

Mean 6.250 Std dev .568 Valid cases 32

- -

C22 Crewmembers' errors and mistakes during the mission, including the pilot-in-command's mistakes, should be a significant part of post flight crew discussions.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	18	56.3
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 6.313 Std dev .592 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	4	12.5
Agree	6	13	40.6
Strongly Agree	7	15	46.9
	Total	32	100.0

Mean 6.344 Std dev .701 Valid cases 32

C23 The pilot-in-command should seek advice from crewmembers when updating mission plans.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	10	31.3
Agree	6	9	28.1
Strongly Agree	7	10	31.3
	Total	32	100.0

Mean 5.781 Std dev 1.07 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	5	15.6
Agree	6	21	65.6
Strongly Agree	7	6	18.8
	Total	32	100.0

Mean 6.031 Std dev .595 Valid cases 32

- -

C24 The pilot-in-command should use his crew to help him maintain situation awareness.

Pretraining Results:

Response	Value	Frequency	Percent
Slightly Agree	5	1	3.1
Agree	6	11	34.4
Strongly Agree	7	20	62.5
	Total	32	100.0

Mean 6.594 Std dev .560 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Agree	6	13	40.6
Strongly Agree	7	19	59.4
	Total	32	100.0

Mean 6.594 Std dev .499 Valid cases 32

C25 The pilot-in-command is solely responsible for maintaining awareness of crew capabilities.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	2	6.3
Disagree	2	15	46.9
Slightly Disagree	3	8	25.0
Neutral	4	2	6.3
Slightly Agree	5	3	9.4
Agree	6	1	3.1
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.875 Std dev 1.40 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	16	50.0
Slightly Disagree	3	5	15.6
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.469 Std dev 1.39 Valid cases 32

- -

C26 Only when the pilot-in-command is overloaded should he pass workload to other crewmembers.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	15	46.9
Disagree	2	13	40.6
Slightly Disagree	3	1	3.1
Agree	6	2	6.3
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 1.969 Std dev 1.53 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	13	40.6
Disagree	2	15	46.9
Slightly Disagree	3	1	3.1
Neutral	4	1	3.1
Strongly Agree	7	2	6.3
Total		32	100.0

Mean 2.000 Std dev 1.48 Valid cases 32

- -

C27 Crewmembers should be aware of other crewmembers' workload.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Slightly Agree	5	4	12.5
Agree	6	17	53.1
Strongly Agree	7	10	31.3
Total		32	100.0

Mean 6.031 Std dev 1.12 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	20	62.5
Strongly Agree	7	10	31.3
Total		32	100.0

Mean 6.250 Std dev .568 Valid cases 32

- -

C28 If a crewmember is having difficulties executing his responsibilities, other crewmembers should provide assistance.

Pretraining Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Agree	6	19	59.4
Strongly Agree	7	9	28.1
Total		32	100.0

Mean 6.125 Std dev .707 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Slightly Agree	5	2	6.3
Agree	6	18	56.3
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 6.313 Std dev .592 Valid cases 32

- -

C29 Highly competent pilots do not experience task overload.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	18	56.3
Disagree	2	12	37.5
Slightly Disagree	3	1	3.1
Neutral	4	1	3.1
	Total	32	100.0

Mean 1.531 Std dev .718 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	18	56.3
Disagree	2	11	34.4
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
	Total	32	100.0

Mean 1.594 Std dev .837 Valid cases 32

- -

C30 A crewmember should offer task help to another crewmember only if he is sure the crewmember needs it.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	15	46.9
Slightly Disagree	3	8	25.0
Neutral	4	1	3.1
Slightly Agree	5	2	6.3
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.500 Std dev 1.29 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	8	25.0
Disagree	2	15	46.9
Slightly Disagree	3	6	18.8
Neutral	4	1	3.1
Slightly Agree	5	1	3.1
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.250 Std dev 1.27 Valid cases 32

- -

C31 The pilot-in-command should not get involved with the execution of responsibilities assigned to other crewmembers

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	3	9.4
Disagree	2	14	43.8
Slightly Disagree	3	9	28.1
Neutral	4	3	9.4
Slightly Agree	5	2	6.3
Agree	6	1	3.1
	Total	32	100.0

Mean 2.688 Std dev 1.17 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	12	37.5
Slightly Disagree	3	9	28.1
Slightly Agree	5	5	15.6
	Total	32	100.0

Mean 2.563 Std dev 1.26 Valid cases 32

C32 Crewmember task overload usually occurs because the crewmember is not very competent.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	7	21.9
Disagree	2	17	53.1
Slightly Disagree	3	2	6.3
Neutral	4	4	12.5
Slightly Agree	5	2	6.3
Total		32	100.0

Mean 2.281 Std dev 1.14 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	9	28.1
Disagree	2	16	50.0
Slightly Disagree	3	6	18.8
Slightly Agree	5	1	3.1
Total		32	100.0

Mean 2.000 Std dev .880 Valid cases 32

- -

C33 Pilots-in-command should employ the same style of leadership in all situations and with all crewmembers.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	12	37.5
Slightly Disagree	3	6	18.8
Neutral	4	2	6.3
Agree	6	5	15.6
Strongly Agree	7	1	3.1
Total		32	100.0

Mean 2.000 Std dev 1.78 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	15	46.9
Slightly Disagree	3	4	12.5
Neutral	4	1	3.1
Slightly Agree	5	3	9.4
Agree	6	3	9.4
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.844 Std dev 1.70 Valid cases 32

- -

C34 Pilot-in-command instructions to other crewmembers should be general and non-specific so that each individual can practice self-management and can develop individual skills.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	9	28.1
Slightly Disagree	3	8	25.0
Neutral	4	5	15.6
Slightly Agree	5	3	9.4
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.813 Std dev 1.44 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	15	46.9
Slightly Disagree	3	3	9.4
Neutral	4	4	12.5
Slightly Agree	5	3	9.4
Agree	6	2	6.3
	Total	32	100.0

Mean 2.719 Std dev 1.46 Valid cases 32

C35 A relaxed attitude is essential for maintaining a cooperative and harmonious cockpit.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	1	3.1
Neutral	4	6	18.8
Slightly Agree	5	6	18.8
Agree	6	11	34.4
Strongly Agree	7	7	21.9
	Total	32	100.0

Mean 5.375 Std dev 1.45 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Slightly Disagree	3	1	3.1
Neutral	4	6	18.8
Slightly Agree	5	4	12.5
Agree	6	16	50.0
Strongly Agree	7	4	12.5
	Total	32	100.0

Mean 5.375 Std dev 1.31 Valid cases 32

C36 Reprimands are more effective than discussions in eliminating a crewmember's poor flying habit.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	9	28.1
Disagree	2	17	53.1
Slightly Disagree	3	2	6.3
Neutral	4	2	9.4
Slightly Agree	5	1	3.1
	Total	32	100.0

Mean 2.063 Std dev 1.01 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	14	43.8
Disagree	2	12	37.5
Slightly Disagree	3	4	12.5
Neutral	4	2	6.3
	Total	32	100.0

Mean 1.813 Std dev .896 Valid cases 32

C37 Nonrated crewmembers should be actively involved in planning the mission.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	3	9.4
Disagree	2	3	9.4
Slightly Disagree	3	4	12.5
Neutral	4	5	15.6
Slightly Agree	5	10	31.3
Agree	6	4	12.5
Strongly Agree	7	3	9.4
	Total	32	100.0

Mean 4.250 Std dev 1.74 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	5	15.6
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	4	12.5
Agree	6	14	43.8
Strongly Agree	7	5	15.6
	Total	32	100.0

Mean 5.031 Std dev 1.80 Valid cases 32

- -

C38 Understanding the commander's concept is of minor importance to mission execution.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	11	34.4
Disagree	2	17	53.1
Slightly Disagree	3	3	9.4
Neutral	4	1	3.1
	Total	32	100.0

Mean 1.813 Std dev .738 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	8	25.0
Disagree	2	17	53.1
Slightly Disagree	3	5	15.6
Slightly Agree	5	1	3.1
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 2.156 Std dev 1.22 Valid cases 32

C39 Each crewmember should watch for situations in which external events limit others' performance.

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Disagree	3	1	3.1
Neutral	4	2	6.3
Slightly Agree	5	8	25.0
Agree	6	17	53.1
Strongly Agree	7	3	9.4
	Total	32	100.0

Mean 5.500 Std dev 1.07 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Agree	5	2	6.3
Agree	6	25	78.1
Strongly Agree	7	4	12.5
	Total	32	100.0

Mean 5.938 Std dev .840 Valid cases 32

C40 Thinking through difficult segments, events, and tasks is primarily the pilot-in-command's responsibility.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	8	25.0
Disagree	2	10	31.3
Slightly Disagree	3	6	18.8
Slightly Agree	5	6	18.8
Agree	6	2	6.3
	Total	32	100.0

Mean 2.750 Std dev 1.62 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	14	43.8
Slightly Disagree	3	7	21.9
Neutral	4	1	3.1
Slightly Agree	5	2	6.3
Agree	6	3	9.4
	Total	32	100.0

Mean 2.688 Std dev 1.46 Valid cases 32

- -

C41 My knowledge of unit SOP and aircraft emergency procedures makes rehearsing familiar missions unnecessary.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	12	37.5
Disagree	2	16	50.0
Slightly Disagree	3	3	9.4
Slightly Agree	5	1	3.1
	Total	32	100.0

Mean 1.813 Std dev 0.85 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	10	31.3
Disagree	2	18	56.3
Slightly Disagree	3	3	9.4
Slightly Agree	5	1	3.1
	Total	32	100.0

Mean 1.875 Std dev .833 Valid cases 32

C42 An essential element of premission planning is discussing crew responsibilities and required actions for abnormal events

Pretraining Results:

Response	Value	Frequency	Percent
Disagree	2	1	3.1
Slightly Disagree	3	1	3.1
Slightly Agree	5	2	6.3
Agree	6	16	50.0
Strongly Agree	7	12	37.5
	Total	32	100.0

Mean 6.094 Std dev 1.11 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Agree	6	14	43.8
Strongly Agree	7	18	56.3
	Total	32	100.0

Mean 6.563 Std dev .504 Valid cases 32

- -

C43 Recent events in my personal life have little to do with my performance as a crewmember.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	5	15.6
Disagree	2	7	21.9
Slightly Disagree	3	6	18.8
Neutral	4	4	12.5
Slightly Agree	5	2	6.3
Agree	6	5	15.6
Strongly Agree	7	3	9.4
	Total	32	100.0

Mean 3.563 Std dev 1.98 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	6	18.8
Disagree	2	5	15.6
Slightly Disagree	3	6	18.8
Neutral	4	3	9.4
Slightly Agree	5	5	15.6
Agree	6	4	12.5
Strongly Agree	7	3	9.4
	Total	32	100.0

Mean 3.625 Std dev 1.99 Valid cases 32

C44 Crewmembers should be able to anticipate requirements as the mission progresses.

Pretraining Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	7	21.9
Agree	6	20	62.5
Strongly Agree	7	4	12.5
Total		32	100.0

Mean 5.844 Std dev .677 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Neutral	4	1	3.1
Slightly Agree	5	6	18.8
Agree	6	18	56.3
Strongly Agree	7	7	21.9
Total		32	100.0

Mean 5.969 Std dev .740 Valid cases 32

- -

C45 My individual performance is as good in degraded systems conditions as it is in a "full up" aircraft.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Disagree	2	5	15.6
Slightly Disagree	3	7	21.9
Neutral	4	4	12.5
Slightly Agree	5	12	37.5
Agree	6	2	6.3
Strongly Agree	7	1	3.1
Total		32	100.0

Mean 3.969 Std dev 1.44 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	2	6.3
Disagree	2	8	25.0
Slightly Disagree	3	4	12.5
Neutral	4	2	6.3
Slightly Agree	5	9	28.1
Agree	6	6	18.8
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 3.938 Std dev 1.44 Valid cases 32

- -

C46 External circumstances require crewmembers to provide situational leadership for short periods of time.

Pretraining Results:

Response	Value	Frequency	Percent
Strongly Disagree	1	1	3.1
Neutral	4	7	21.9
Slightly Agree	5	8	25.0
Agree	6	15	46.9
Strongly Agree	7	1	3.1
	Total	32	100.0

Mean 5.188 Std dev 1.14 Valid cases 32

Post-training Results:

Response	Value	Frequency	Percent
Neutral	4	2	6.3
Slightly Agree	5	4	12.5
Agree	6	21	65.6
Strongly Agree	7	5	15.6
	Total	32	100.0

Mean 5.906 Std dev .734 Valid cases 32

Appendix B

Aircrew Coordination Evaluation (ACE) Checklist and Basic Qualities, and Frequency Tables

Note: The Aircrew Coordination Evaluation (ACE) Checklist, developed for use in the Field Exportable Evaluation Package, is presented here as an index to the crew coordination Basic Qualities

Appendix B-1

Behavioral Anchored Ratings

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

For use of this form, see Aircrew Coordination Exportable Evaluation Package for Army Aviation.

PC_____ Date _____

PI _____

NCM _____

_____

NO	CREW COORDINATION BASIC QUALITIES	RATING
1	Establish and maintain flight team leadership and crew climate (Crew Climate)	
2	Premission planning and rehearsal accomplished (Plan Rehearse)	
3	Application of appropriate decision making techniques (Decision Tech)	
4	Prioritize actions and distribute workload (Workload)	
5	Management of unexpected events (Unexp Events)	
6	Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)	
7	Maintenance of mission situational awareness (Sit Aware)	
8	Decisions and actions communicated and acknowledged (Comm/Ack)	
9	Supporting information and actions sought from crew (Info Sought)	
10	Crewmember actions mutually cross-monitored (Cross Monitor)	
11	Supporting information and actions offered by crew (Info Offered)	
12	Advocacy and assertion practiced (Advoc/Assert)	
13	Crew-level after-action reviews accomplished (AAR)	

Evaluator's Signature:

Notes:
Consult the behavioral anchored rating guidance. Enter a summary rating (1, 2 ... 7) in the rating block for each Basic Quality. Refer to the rating scale below.

RATING SCALE

Very Poor	Poor	Marginal	Acceptable	Good	Very Good	Superior
1	2	3	4	5	6	7

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

Rating Scale

The following numeric rating scale is used to assess the level of behavior that crews exhibit for each basic quality shown on the Aircrew Coordination Evaluation (ACE) Checklist and at the bottom of the Aircrew Coordination Training Grade Slip. Each basic quality is rated using a seven-point scale with values ranging from 1 (very poor) to 7 (superior):

Very Poor	Poor	Marginal	Accept-able	Good	Very Good	Superior
1	2	3	4	5	6	7

Rating Guidelines

Written descriptions of the types of behaviors and levels of performance are shown for rating values 1, 4, and 7. These descriptions serve as behavioral "anchors" and are designed to assist evaluators in determining how well a crew performs on each basic quality in relation to a well-defined set of behaviors. Evaluators should use the "anchors" as the standard for making ratings--avoid comparing one crew's performance with that of another crew's; rate a crew's performance in relation to the "anchors." To ensure reliable ratings, continue to refer to the anchors when making rating responses until *completely* confident and understand *fully* how to rate each basic quality.

In completing a basic quality rating, evaluators should decide whether the behaviors observed fall into the low end of the basic quality range (values 1 or 2), the middle of the range (values 3, 4, or 5), or the high end of the range (values 6 or 7). Once the general range of response is selected, use the anchors to help select the final rating value. For example, if a crew did an adequate job of pre-mission planning and rehearsal, the rating would come from the middle of the range (3, 4, or 5). After determining this, review the behavioral description (anchor) associated with value 4 to determine if crew performance resembled this description (4 value), was somewhat less than this description (3 value), or was a little better than this description (5 value). Use the end-point anchors similarly to help determine ratings that fall near the ends of the scale.

Army aviation crews that have little or no training in aircrew coordination techniques will score most frequently in the lower half of the scale. Most other crews, however, will fall into the middle area of the scale. Keep in mind that although Army aviators have well developed basic flying skills, as a group, their aircrew coordination skills will be much like the rest of the population. A few crews will have strong coordination and communication skills, a few will have weak skills, and a significant number will have moderate skills.

Aircrew Coordination Basic Qualities and Behavioral Anchors

BASIC QUALITY 1. Establish and maintain flight team leadership and crew climate (Crew Climate)

Explanation:

This rating assesses the quality of relationships among the crew and the overall climate of the flight deck. Aircrews are teams with a designated leader and clear lines of authority and responsibility. The pilot-in-command sets the tone of the crew and maintains the working environment. Effective leaders use their authority but do not operate without the participation of other crewmembers. When crewmembers disagree on a course of action, rate the crew's effectiveness in resolving the disagreement. Note: Traditional leadership centralizes leadership in the leader with followers fully dependent on the leader. Functional leadership assigns leadership and followership roles as the situation evolves. Flight team leadership recognizes the impact of leadership style on the working environment. Regardless of leadership style, the pilot-in-command retains final decision and direction authority.

Superior Rating (7)

The crewmembers have very good interpersonal relationships. They respect each others' skills and appear to enjoy being with each other. The climate is very open; crewmembers freely talk and ask questions. Crewmembers encourage the individual with the most information about the situation-at-hand to participate. There is a genuine concern for good working relationships. No degrading comments or negative voice tones are used in interactions. Disagreements are perceived as a normal part of crew interactions, and the crew directly confronts the issues over which the disagreement began. Arguments or disagreements focus on behaviors or solutions rather than on personalities. Each crewmember carefully listens to others' comments. Senior crewmembers accept challenges from junior crewmembers. Alternative solutions are explored. The solution produced is a "win-win" situation in which all crewmembers' opinions are considered. The crewmembers have no hard feelings at the conclusion of the incident.

Acceptable Rating (4)

The crewmembers have sound interpersonal relationships and seem to respect each others' skills. The climate is an open one, and crewmembers are free to talk and ask mission questions. Regardless of rank or duty position, the individual with the most information about the situation-at-hand is allowed to participate. When disagreements arise, the crew directly

confronts the issues over which the disagreements began. The primary focus is on behaviors or solutions, and no personal attacks are made in the heat of discussion. The solution is generally seen as reasonable. Problem resolution ends on a positive note with very little hostility or grumbling among crewmembers. Mutual respect is clearly intact.

Very Poor Rating (1)

Crew interactions are often awkward and uncomfortable. The crewmembers do not appear to like or respect each other. Crewmembers may be curt and impolite to each other. Requirements for assistance are made as commands rather than as requests for support. When disagreements arise, the crew fails to directly confront the issues. Personal attacks may arise. Senior crewmembers are resistant to recommendations from junior crewmembers. Crewmembers do not explore the range of possible solutions. They may shout and argue without finding a solution. One or more crewmembers may retreat and say nothing at all. A "win-lose" situation develops in which one crewmember is shown to be right and the other to be wrong. The crewmembers show little respect to one another except for deferring to formal rank.

BASIC QUALITY 2. Pre-mission planning and rehearsal accomplished (Plan Rehearsal)

Explanation:

This rating assesses the pre-mission planning and rehearsal activities that the crew performs upon receiving a mission order. Time available determines whether pre-mission planning and rehearsal is completed prior to the flight or in the cockpit. During this period crews--

- Clarify the mission order and the commander's intent
- Assign actions, duties, and mission responsibilities
- Collect information (intelligence, communications, weather, flight planning) and develop the plan
- Conduct crew briefing to review and discuss the plan
- Identify potential problem areas and courses of action
- Assess risks
- Visualize and rehearse the mission

Although the pilot-in-command is responsible for leading this activity, evaluate the extent and manner in which the entire crew participates. Also, consider the time constraints on the crew. If there is insufficient time to conduct comprehensive planning and rehearsal, evaluate the crew on their planning and rehearsal of

the most critical segments of the mission. That is, either prior to the flight or in the cockpit, did the crew address the most important issues given the time available? Note: The relationship among crew members should be observed during this period but the crew climate evaluation should be made on rating basic quality 1, Flight Team Leadership and Crew Climate.

Examples:

•UH-60 Task 2078 and AH-64 Task 1033, Perform terrain flight mission planning: The crew will analyze the mission in terms of METT-T and plan the flight as directed by the PC. The crew will rehearse important aspects of the mission.

•UH-60 and AH-64 Task 1000, Conduct crew mission briefing: Aircrew collectively visualizes and rehearses expected and unexpected events from takeoff to tie-down; all factors of the flight; and actions, duties, and responsibilities of each crewmember.

•AH-64 and UH-60 Task 1068, Perform or describe emergency procedures: PC will include in the crew briefing the general approach to all emergency procedures requiring immediate action.

Superior Rating (7)

The entire crew discusses a detailed description of the mission and the commander's intent. All actions, duties, and mission responsibilities are partitioned and clearly assigned to specific individuals. The crew acquires new and updated information and uses it to develop the mission plan from the aircrew mission briefing. Questions and discussion about the mission, commander's intent, and specific responsibilities are encouraged. Potential problems are noted and discussed in detail. Courses of action and individual responsibilities are established in the event that potential problems actually occur. All crewmembers speak out and acknowledge an understanding of the operational risks in the mission plan. The pilot-in-command leads the crew in mentally rehearsing the entire mission by visualizing and talking the crew through potential problems and contingencies. Crewmembers acknowledge understanding their assigned responsibilities and cues for actions. The tone of the interaction is friendly and professional.

Acceptable Rating (4)

A brief description of the mission is provided to the entire crew. The mission responsibilities are partitioned and assigned to specific individuals. Actions are taken to update current information that adds to the aircrew mission briefing and helps develop the mission plan. One or more crewmembers make comments during the course of developing the mission plan. Potential mission problems are only briefly discussed. There is adequate

preparation for contingencies. Crewmembers briefly discuss the operational risks in the mission plan. Mental rehearsal is initiated by the pilot-in-command or another crewmember who talks through potential problems or contingencies for one or more mission segments. Some discussion takes place to clarify responsibilities in the event of unexpected problems or contingencies. The tone of the interaction is generally friendly and businesslike.

Very Poor Rating (1)

The pilot-in-command briefs the mission with little or no attendant explanation. There is little or no discussion of responsibilities or their assignments to specific crewmembers. The pilot-in-command develops the mission plan from the aircrew mission briefing and current information. Crewmembers tend not to ask questions about the mission. If asked, questions tend to be cut off, only briefly addressed, or ignored by the other crew-members. Little or no mention is given to potential problems or complications. No crewmember says anything about operational risks or weaknesses in the plan. Any suggestion to talk through a potential problem or mentally rehearse responsibilities is rejected as unnecessary. The tone of the interaction is business-like, abrupt, and impersonal.

BASIC QUALITY 3. Application of appropriate deci-making techniques (Decision Tech)

Explanation:

This rating evaluates the manner and quality of the crew's problem solving and decision making performance throughout the planning and execution of the mission. Factors to consider in making this evaluation include (1) information available to the crewmembers, (2) time urgency of the decision, (3) objectivity reflected in the decision process, and (4) level of involvement and information exchange among the crewmembers. The time critical demands of tactical flying require many decisions to be made on an automatic, pattern-recognition basis with only a minimum level of information exchange. However, when adequate time and information are available, crewmembers are expected to engage in a more deliberate and interactive style of decision making. The evaluation of crew decision making performance should ask the following questions: (1) Did the crew use all of the available information? (2) Was the level of information exchange among crewmembers appropriate for the time available? (3) Was the type of decision process (deliberate versus automatic) appropriate for the time available?

Examples:

•UH-60 and AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation, then choose a course of action that supports the intent of the unit commander's directives.

•AH-64 and UH-60 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

Superior Rating (7)

Crew decision making consistently reflects proper attention to available information throughout mission planning and execution. The level of crew participation and deliberate analysis of options is appropriate for the decision time available. Resulting decisions are timely and appropriate given the time urgency and level of information available in each situation. Crewmembers do not exhibit any of the known hazardous thought patterns (e.g., anti-authority, impulsivity, machoism, invulnerability, resignation, get-home-itis, overconfidence in other aviator) and appear motivated to seek the most mission effective and safe decision in each situation. The crew decides and implements a course of action before the situation jeopardizes crew performance or mission accomplishment.

Acceptable Rating (4)

Crew decisions occasionally reflect inadequate sharing or use of available information. On limited occasions, crewmembers dwell excessively on some issues while neglecting more time urgent requirements. Most decisions are timely, but crew performance begins to show signs of self-induced stress. Most decisions are appropriate for the situation, with the crew occasionally overlooking one or more factors or options. Crewmembers occasionally fail to recognize or exploit opportunities for additional planning or rehearsal, substituting instead *ad hoc* strategies or plans. Crewmembers do not exhibit any of the known hazardous thought patterns. The situation may worsen, without seriously degrading mission accomplishment, before the crew decides and implements a course of action.

Very Poor Rating (1)

Crew performance (both pre-flight and in-flight) reflects an inflexible style of decision making (either deliberate or automatic) regardless of time urgency. Crewmembers may engage in excessive deliberation, overlook the relative time urgency of competing decision requirements, or fall victim to inappropriate mind sets. As a result, decisions frequently lack timeliness, ignore important factors, or appear out of context. Information

exchange and crewmember interaction is minimal, with the result that critical input is ignored or not sought. Crewmembers may display one or more of the known hazardous thought patterns (e.g., machoism, anti-authority, get-home-itis). The crew may be unable to decide or implement a course of action before a situation becomes critical.

BASIC QUALITY 4. Prioritize actions and distribute workload (Workload)

Explanation:

This is a rating of the effectiveness of time and work management. Rate the extent to which the crew as a team avoids being distracted from essential activities, distributes workload, and avoids individual crewmember overload.

Examples:

•AH-64 and UH-60 Task 1080, Perform procedures for two-way radio failure: P* will remain focused outside the aircraft or inside the cockpit on the instruments, as appropriate. He will not participate in troubleshooting the malfunction.

•UH-60 Task 2079 and AH-64 Task 1064, Perform terrain flight navigation: P will focus his attention primarily inside the cockpit; however, as workload permits, he will assist in clearing the aircraft and provide adequate warning of traffic and obstacles.

Superior Rating (7)

Virtually all distractions are avoided. Each crewmember understands precisely what information is relevant to the mission and what information is simply a distraction. If a crewmember becomes mildly distracted, other crewmembers remind him to focus on the mission task. Non-critical duties are prioritized and delayed until low workload periods or post-flight periods. Crewmembers are aware of workload build ups on others and readjust workload by assuming emerging, unassigned tasks appropriate for their duty station. Overloads do not occur. The crew's planning horizon is always "ahead of the aircraft."

Acceptable Rating (4)

Most distractions are avoided. The crew performs well in deciding what information and activities are essential to the

mission. Most non-essential information is discarded or ignored. Non-critical duties are prioritized and delayed until low workload periods or post-flight periods. Crewmembers are aware of individual crewmember workloads during each phase of the mission. When an individual crewmember appears to be overloaded, other crewmembers take on part of the workload. The crew is always "in sync with the aircraft."

Very Poor Rating (1)

The crew is easily distracted. The crew is unable or unwilling to decide what is important and relevant to the immediate mission. There is little prioritizing of duties or actions. Time and energy may be wasted on low priority tasks. Risks to crew safety may occur as the crew focuses on minor tasks while critical tasks requiring immediate attention go unattended, (e.g., setting a radio frequency when attention should be focused on clearing an obstacle.). Neither the overloaded party nor other crewmembers takes voluntary actions to eliminate an overload condition. The crew makes little or no effort to redistribute task responsibilities as mission changes occur and new tasks arise. Individual crewmembers experience workload overloads. The crew's planning horizon is sometimes "behind the aircraft."

BASIC QUALITY 5. Management of unexpected events (Unexp Events)

Explanation:

This rating evaluates the crew's performance under unusual circumstances that may involve high levels of stress. This judgement includes the integration of technical and managerial aspects of contending with the situation. Note: Enter the abnormal or emergency situation in the Aircrew Coordination Training Grade Slip (some emergency procedure ATM tasks are preprinted) and grade it the same as any task.

Examples:

•AH-64 and UH-60 Task 2008, Perform evasive maneuvers: The most important consideration in an emergency is aircraft control--first assess aircraft controllability, check systems indicators, take evasive action.

•UH-60 Task 1068, Perform or describe emergency procedures: CE will keep communications to a minimum to allow the P* or P to attempt communications outside the aircraft.

Superior Rating (7)

The crew remains calm during the situation. Each crewmember seeks to understand the problem and provides the pilot-in-command with essential information. Each crewmember immediately takes on particular workload responsibilities based on prior discussions and rehearsal of potential problems and contingencies. The crew effectively communicates its actions and results to others and provides feedback to ensure complete coordination of efforts. Each crewmember handles his own responsibilities and seeks to support the crewmember with the greatest workload. The crew rapidly imposes the maximum amount of control possible over the situation given the available time and internal and external resources. A high level of situation awareness is maintained throughout the event.

Acceptable Rating (4)

The crew responds to the problem and the pilot-in-command's requests for information but does not overreact. The pilot-in-command's requests for information are met by feedback from the crew. The crew takes actions to reduce the pilot-in-command's work overload and provides information even if it is not specifically requested. The pilot and crew make good use of available resources. The crew is intense but not flustered by the situation. Adequate situation awareness is maintained throughout the event.

Very Poor Rating (1)

The crew becomes disorganized and flustered. The pilot-in-command's requests for information elicit inadequate responses. Crewmembers may focus on the wrong issues, thus delaying correct diagnosis of the problem. The crew focuses on only one solution to an event, does not consider other plausible alternatives, or chooses an inappropriate solution. Lack of coordinated actions adds to the confusion. The pilot and crewmembers make poor use of available resources to resolve the problem. Situation awareness appears to decay during the situation.

BASIC QUALITY 6. Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)

Explanation:

Rate the completeness, timeliness, and quality of information transfer. Carefully consider the crew's feedback techniques to

verify information transfer. In particular, evaluate the quality of instructions and statements associated with navigation activities, obstacle clearing activities, and instrument readouts.

Examples:

•AH-64 Task 1015, Perform ground taxi: The P will announce "Blocking" to acknowledge the P*'s announcement "Braking".

•UH-60 Task 2079, Perform terrain flight navigation: The P* will acknowledge commands issued by the P for heading and airspeed changes.

Superior Rating (7)

Crewmembers communicate frequently. Both senders and receivers use standard terminology for nearly all communications. Senders almost always provide clear, concise information. Receivers acknowledge nearly all messages in sufficient detail so that the sender can verify that the receiver understands the message. Receivers ask for clarification when they do not understand. Senders pursue feedback when no response is forthcoming. Whenever a workload shift or task responsibility transfer occurs, the change is communicated and acknowledged by the crew. All navigation, obstacle clearing, and "inside" or "outside" the cockpit information is stated, acknowledged, and updated.

Acceptable Rating (4)

Crewmembers communicate about the mission as required. Standard terminology is usually used. Receivers acknowledge most messages. Receivers ask questions when they do not understand. Senders usually pursue feedback when no response is forthcoming. Crewmembers are appraised of changes to responsibilities during the flight. "Inside" and "outside" the cockpit duties are specified and communicated to others.

Very Poor Rating (1)

Crewmembers may fail to make statements regarding critical information. Non-standard terminology is used or standard terminology is used inappropriately. Sender messages may be inappropriately delayed or irregular and may be confusing. Receivers usually do not verbally acknowledge the receipt of messages. Receivers do not ask questions. Senders do not pursue feedback when no response is forthcoming. Changes in responsibilities during the mission are often not communicated and may result in confusion over who has a task responsibility. Navigation instructions and obstacle location information may be incomplete or confusing. At times, "inside" or "outside" the cockpit responsibilities are not clearly communicated.

BASIC QUALITY 7. Maintenance of mission situation awareness (Sit Aware)

Explanation:

This rating assesses the extent to which crewmembers keep each other informed on the status of the aircraft and mission accomplishment. This information reporting helps maintain a high level of situation awareness among the flight crew. Information reported includes:

•Aircraft position and orientation
•Equipment status
•Personnel status
•Environment and battlefield conditions
•Changes to mission objectives

Crew-wide situation awareness is an essential element of safe flying and effective crew performance.

Examples:

•UH-60 Task 2009, Perform multi-aircraft operations: P and CE will provide adequate warning to avoid traffic or obstacles.

•AH-64 Task 2008, Perform evasive maneuvers: When engaged by the enemy, crew will announce the nature and direction of the threat.

Superior Rating (7)

Crewmembers routinely provide each other with updates on the status of the elements of situation awareness and the status of the mission. Crewmembers anticipate the situation awareness needs of others and request needed information when it is not forthcoming. Crewmembers are aware of each others' mental and physical states and are not hesitant to alert others to personal problems that could undermine effective performance. Personnel status is voluntarily shared without fear of sanctions. All changes in the elements of situation awareness are verbalized and acknowledged. Crewmembers alert other crewmembers to the presence of obstacles.

Acceptable Rating (4)

Crewmembers usually provide updates on the status of most of the elements of situation awareness and the status of the mission. Changes to the situation awareness elements are verbalized. Obvious changes in personnel status are noted and acknowledged without fear of sanctions.

Very Poor Rating (1)

Crewmembers do not routinely provide updates on the status of the aircraft or the status of the mission. Generally, updates are provided only on request; they are not made voluntarily. Personnel problems such as fatigue or lack of attention are not mentioned.

BASIC QUALITY 8. Decisions and actions communicated and acknowledged (Comm/ Ack)

Explanation:

Rate the extent to which decisions and actions are actually made and announced to the crewmembers after input is solicited from them. Crewmembers should respond verbally or with the appropriate adjustment to their behaviors, actions, or control inputs to clearly indicate that they understand when a decision has been made and what it is. Failure to do so may confuse crews and lead to uncoordinated operation. Note: Due to time constraints in certain situations, there is often little or no time for crews to make inputs to a decision. In such cases, raters should focus on the extent to which decisions are acknowledged verbally or through coordinated, pre-planned action.

Examples:

•UH-60 Task 2086, Perform masking and unmasking: P* will announce his intent to unmask. The P and CE will acknowledge that they are prepared to execute the maneuver.

•AH-64 Task 1038, Perform terrain flight approach: P* will announce intention of a go-around . . . whether approach will terminate to a hover or to the ground. P will acknowledge use of manual stabilator or any intent to deviate from the approach.

Superior Rating (7)

The pilot-in-command states decisions and actions and, time permitting, explains the reasons and intent. Crewmembers acknowledge the decisions with a clear verbal response and ask questions to clarify any confusion. The pilot-in-command answers all questions in a positive, straight-forward manner. Crewmembers keep the pilot-in-command informed of the results of their activities and changing responsibilities--especially visual area of responsibility or task focus. The crew clearly acknowledges results of actions, or changes, and then states its intended adjustments based on the information provided. If crewmembers do not acknowledge or adjust, the pilot-in-command

requests acknowledgement. Crewmembers are particularly attentive to the communication of workload responsibilities. When assuming control of the aircraft or making control inputs, notification is always given and acknowledgement received.

Acceptable Rating (4)

The pilot-in-command states decisions and actions along with, time permitting, a brief explanation of the reasons and informs the crew of the adjustments they are expected to make. The crew acknowledges its awareness of the decisions and directions. Crewmembers may ask questions to clarify confusion. The pilot answers questions clearly and quickly and the crew adjusts to the new situation. When assuming control of the aircraft or making control inputs, notification is given and acknowledged.

Very Poor Rating (1)

Decisions and actions of a crewmember are often not passed on to the crew. The pilot-in-command takes unilateral action and does not explain or inform the crew of his intended purpose. The crew is often not aware that a decision has been made. The crew infrequently asks questions for clarification. The pilot-in-command may not acknowledge or respond to questions. The crew may not know how to react to changed circumstances. Crewmembers are often unsure what responsibilities have been assigned to them. Crewmembers may take uncoordinated actions without stating intentions or results. Two pilots may attempt to simultaneously take control of the aircraft when flight control authority is unclear.

BASIC QUALITY 9. Supporting information and actions sought from crew (Info Sought)

Explanation:

This is a rating of the extent to which crewmembers, usually the pilot-in-command, seek support information and support actions from the crew. Evaluate the degree to which crewmembers raise questions during the flight regarding plans, revisions to plans, actions to be taken, and the status of key mission information. Note: The extent to which crewmembers maintain situational awareness and contribute to decision making should be observed here but evaluated on basic qualities 7 and 4 respectively.

Examples:

•UH-60 Task 1032, Perform slope operations: P* will request assistance in setting the brakes.

•AH-64 Task 2044, Perform actions on contact: The crew will discuss options for developing the situation.

Superior Rating (7)

During the flight, crewmembers raise questions on plans or changes to plans and actions. Virtually all of these inquiries surface information that contributes to the mission decision making process. When the pilot-in-command realizes that a decision must be made during the flight, for which there is no clear standardized answer, he immediately alerts the crew to the situation and seeks suggestions on possible solutions and important information to consider. The pilot-in-command is open to all suggestions. Crewmembers respond to these inquiries with sound, task-focused discussions and clear answers that are provided in a timely manner. Crewmembers' inquiries are never ignored. All crewmembers encourage such questioning. When the pilot-in-command asks for assistance with actions he clearly states what assistance is required. He provides quick, clear feedback if the crewmember response is not what he expects. He asks for assistance before becoming overloaded.

Acceptable Rating (4)

During the flight, crewmembers occasionally raise questions on plans or actions when they are unclear on decisions being made. Most of these inquiries provide information that is relevant to the mission decision making process. The pilot alerts the crew to the need for decision input. Crewmembers usually respond to these inquiries with brief but reasonable answers. Crewmembers' inquiries are encouraged by other crewmembers most of the time. The pilot-in-command listens to suggestions without interruption or criticism. He asks for clarification as necessary. He only asks for assistance when he becomes overloaded.

Very Poor Rating (1)

During the flight, crewmembers almost never raise questions about plans, actions, or changes to plans. The pilot-in-command makes mission decisions without seeking inputs from other crewmembers. The pilot-in-command does not alert the crew that a decision is required or is being made. Decision making and planning are done by one individual with little or no discussion--an observer will have difficulty noting this quality for "very poor" crews since it is hard to detect individual decision making. The few inquiries that are made are generally ignored or abruptly answered. Crewmembers may discourage others from asking questions by the tone of voice they use or by failing to respond.

The pilot-in-command may not ask for crew assistance with tasks even when he is overloaded to the point of nearly failing to properly execute tasks.

BASIC QUALITY 10. Crewmember actions mutually cross monitored (Cross Monitor)

Explanation:

This rating captures the extent to which a crew uses cross monitoring as a mechanism to avoid errors and improve future performance. Crewmembers are able to catch each other's errors. Such redundancy is particularly important when crews are fatigued or overly focused on critical task elements, and thus more prone to make errors. Included in this rating is the crew's use of aircraft technical manual checklists to perform required procedure checks and procedures (i.e., engine-start, run-up, before-takeoff, before- and after-landing, shutdown checks; HIT and emergency procedures). Note: This quality does not imply that task responsibilities are not clearly defined. It asks the question "To what extent do crewmembers help an individual assigned primary responsibility for a task or action by reviewing the quality of that individual's task execution and alerting him to any mistake noted?"

Examples:

•AH-64 Task 1094, Identify major US or allied equipment and major threat equipment: P* or P will announce the type and direction of the equipment detected. The other crewmember will confirm the type and direction of the equipment.

•UH-60 task 1023, Perform fuel management procedures: PC will confirm the results of the fuel check.

Superior Rating (7)

Each crewmember is concerned that all tasks are properly executed and checks both his tasks and those of others. When mistakes are noted, the crewmember making the error is quickly informed in a concise manner without excessive formality. The mistake maker accepts this review and feedback as a normal part of crew operations.

Acceptable Rating (4)

Crewmembers often check each other's task performance for errors. Mistake makers are informed and make the needed corrections. Only

occasionally are mistake makers annoyed at being checked and corrected.

Very Poor Rating (1)

Crewmembers seldom, if ever, check each other's task execution. Crewmembers are insulted if they are corrected by another crewmember.

BASIC QUALITY 11. Supporting information and actions offered by crew (Info Offered)

Explanation:

This is a rating of the extent to which crewmembers anticipate and offer support information and support actions to the decision maker, usually the pilot-in-command, when it becomes apparent that a decision must be made or an action taken.

Examples:

•UH-60 Task 2016, Perform external load operations: All crewmembers will assist in clearing the aircraft and will provide adequate warning of obstacles, unusual drift, or altitude changes.

•UH-60 and AH-64 Task 1081, Perform nonprecision approach: P will call out the approach procedure to the P*.

Superior Rating (7)

The crew recognizes that a decision must be made and offers suggestions and information to the pilot-in-command. The crew checks for responses that indicate understanding. The information is repeated, as necessary, to ensure that the pilot-in-command understands the input. Pilot-in-command responses can be verbal or non-verbal actions. The crew seeks information and provides it to support decisions and actions. The crew frequently offers task execution support. The support offered always reflects the pilot-in-command's task needs. Crews are quick to offer support during particularly difficult tasks such as obstacle clearing.

Acceptable Rating (4)

The crew recognizes that a decision or action must be made and offers suggestions and information to the pilot-in-command. The crew sometimes offers task execution support. Crewmembers usually offer obstacle clearing support.

Very Poor Rating (1)

The crew does not offer suggestions and inputs to support decision making or actions. Moreover, it often appears that the crew does not even realize that a decision is being made. The crew generally does not offer its services to support task execution for other crewmembers. Crewmembers may fail to offer obstacle clearing support.

BASIC QUALITY 12. Advocacy and assertion practiced (Advoc/Assert)

Explanation:

This rating evaluates the extent to which crewmembers advocate a course of action they consider best, even when it may differ with the one being followed or proposed. Note: Except under extreme emergency conditions where time is absolutely

critical, it is usually in the crew's best interest to hear the full range of viewpoints available.

Examples:

•UH-60 and AH-64 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

•AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation.

Superior Rating (7)

Crewmembers state to the rest of the crew a course of action that they consider best. They clearly explain their reasons for believing this to be the best course. Other crewmembers listen to the argument before presenting any criticism or proposing alternate courses. Discussions focus on the strengths and weaknesses of the proposed course of action, not on the personality of the crewmember who proposed the action.

Crewmembers call the crew's attention to changes in the situation and provide information that is essential to the proper execution of another crewmember's task. Crewmembers pursue feedback to ensure that their views are heard and understood. Other crewmembers expect such open comments and view them as positive contributions to mission performance.

Acceptable Rating (4)

Crewmembers state their support for a course of action or suggest improvements to other proposed actions. Each crewmember makes an effort to explain his position and convince others to concur with him on the course of action to be taken. Other crewmembers may interrupt with their views and alternatives. Crewmembers usually speak out when they recognize a departure from the mission plan or standard procedures or when they have a piece of information that is important to another's task execution. Crewmembers seek assurances that presented information has been received. Other crewmembers view such comments as constructive and not as a challenge to authority.

Very Poor Rating (1)

The crew almost never suggests a course of action. Crewmembers attempting to propose a course of action may be cut-off before they can propose the action or explain the rationale for that action. Crewmembers proposing courses of action may receive personal attacks. The crew raises few, if any concerns. Crewmembers may even fail to intervene when risks such as obstacles or poor visibility arise.

BASIC QUALITY 13. Crew-level after-action reviews accomplished (AAR)

Explanation:

This rating evaluates the extent to which the crew reviews and critiques its decisions and actions during or following a mission segment, during low workload periods, or during the post flight debrief. Evaluate the crew on their discussion of strengths and weaknesses (for example, what was done wrong, what might be done better, how improvements can be made, and what was done very well) in flight skills and aircrew coordination.

Superior Rating (7)

The entire crew reviews and critiques its decisions and actions throughout the mission, including the pre-mission planning and rehearsal process. Crewmembers review factors considered in making their decisions, identify additional options or factors,

including ways to "buy time," that should have been considered, and discuss different methods of weighing information in the decision process. All discussions focus on behaviors and information and carefully avoid any "finger-pointing" tones. The focus is clearly on education and understanding to improve individual and collective performance.

Acceptable Rating (4)

Senior crewmember(s) review and critique the crew's decisions and actions during problematic segments of the mission. They determine the major mistakes in the crew's actions or decisions and identify remedial actions or alternative options for future missions. Although the critiques are intended to educate the crew and to improve their performance during future missions, they may include some accountability for unsatisfactory performance.

Very Poor Rating (1)

The crew either fails to review and critique its mission performance or if a critique is performed, it is punitive or accusatory. That is, the critique is conducted primarily to assign blame for unsatisfactory performance. Little effort is made to identify lessons learned or to suggest constructive ways to improve future performance.

APPENDIX B-2

ACE CHECKLIST FREQUENCY TABLES

BQ1 Establish and maintain flight team leadership and crew climate

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	1	6.3
Marginal	3	3	18.8
Acceptable	4	8	50.0
Good	5	4	25.0
	Total	16	100.0

Mean 3.938 Std dev .854 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Acceptable	4	6	37.5
Good	5	6	37.5
Very Good	6	1	6.3
Superior	7	3	18.8
	Total	16	100.0

Mean 5.063 Std dev 1.124 Valid cases 16

- -

BQ2 Premission planning and rehearsal accomplished

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	3	18.8
Marginal	3	10	62.5
Acceptable	4	2	12.5
Good	5	1	6.3
	Total	16	100.0

Mean 3.063 Std dev .772 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Poor	2	1	6.3
Acceptable	4	8	50.0
Good	5	3	18.8
Very Good	6	3	18.8
Superior	7	1	6.3
	Total	16	100.0

Mean 4.625 Std dev 1.204 Valid cases 16

BQ3 Selection of appropriate decision models

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	1	6.3
Marginal	3	11	68.8
Acceptable	4	4	25.0
	Total	16	100.0

Mean 3.188 Std dev .544 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	1	6.3
Acceptable	4	11	68.8
Good	5	3	18.8
Superior	7	1	6.3
	Total	16	100.0

Mean 4.313 Std dev .873 Valid cases 16

- -

BQ4 Prioritize actions and distribute workload

Pretraining Results:

Rating	Value	Frequency	Percent
Very Poor	1	1	6.3
Poor	2	3	18.8
Marginal	3	8	50.0
Acceptable	4	4	25.0
	Total	16	100.0

Mean 2.938 Std dev .854 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	2	12.5
Acceptable	4	9	56.3
Good	5	2	12.5
Very Good	6	2	12.5
Superior	7	1	6.3
	Total	16	100.0

Mean 4.438 Std dev 1.094 Valid cases 16

BQ5 Management of unexpected events

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	5	31.3
Marginal	3	7	43.8
Acceptable	4	4	25.0
		-------	-------
	Total	16	100.0

Mean 2.938 Std dev .772 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	5	31.3
Acceptable	4	6	37.5
Good	5	4	25.0
Superior	7	1	6.3
		-------	-------
	Total	16	100.0

Mean 4.125 Std dev 1.088 Valid cases 16

- -

BQ6 Statements and directives clear, timely, relevant, complete, and verified

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	4	25.0
Marginal	3	7	43.8
Acceptable	4	4	25.0
Good	5	1	6.3
		-------	-------
	Total	16	100.0

Mean 3.125 Std dev .885 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	2	12.5
Acceptable	4	8	50.0
Good	5	4	25.0
Very Good	6	1	6.3
Superior	7	1	6.3
		-------	-------
	Total	16	100.0

Mean 4.438 Std dev 1.031 Valid cases 16

BQ7 Maintenance of mission situational awareness

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	6	37.5
Marginal	3	7	43.8
Acceptable	4	3	18.8
	Total	16	100.0

Mean 2.813 Std dev .750 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Poor	2	2	12.5
Marginal	3	6	37.5
Acceptable	4	4	25.0
Good	5	3	18.8
Superior	7	1	6.3
	Total	16	100.0

Mean 3.750 Std dev 1.291 Valid cases 16

- -

BQ8 Decisions and actions communicated and acknowledged

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	3	18.8
Marginal	3	6	37.5
Acceptable	4	7	43.8
	Total	16	100.0

Mean 3.250 Std dev .775 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Poor	2	1	6.3
Marginal	3	2	12.5
Acceptable	4	6	37.5
Good	5	3	18.8
Very Good	6	2	12.5
Superior	7	2	12.5
	Total	16	100.0

Mean 4.563 Std dev 1.413 Valid cases 16

BQ9 Supporting information and actions sought from crew

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	3	18.8
Marginal	3	7	43.8
Acceptable	4	5	31.3
Good	5	1	6.3
	Total	16	100.0

Mean 3.250 Std dev .856 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	5	31.3
Acceptable	4	7	43.8
Good	5	1	6.3
Very Good	6	2	12.5
Superior	7	1	6.3
	Total	16	100.0

Mean 4.188 Std dev 1.223 Valid cases 16

- -

BQ10 Crewmember actions mutually cross monitored

Pretraining Results:

Rating	Value	Frequency	Percent
Very Poor	1	2	12.5
Poor	2	6	37.5
Marginal	3	3	18.8
Acceptable	4	5	31.3
	Total	16	100.0

Mean 2.688 Std dev 1.078 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Poor	2	1	6.3
Marginal	3	7	43.8
Acceptable	4	4	25.0
Good	5	2	12.5
Very Good	6	1	6.3
Superior	7	1	6.3
	Total	16	100.0

Mean 3.875 Std dev 1.310 Valid cases 16

BQ11 Supporting information and actions offered by crew

Pretraining Results:

Rating	Value	Frequency	Percent
Very Poor	1	1	6.3
Poor	2	4	25.0
Marginal	3	3	18.8
Acceptable	4	7	43.8
Good	5	1	6.3
	Total	16	100.0

Mean 3.188 Std dev 1.109 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	5	31.3
Acceptable	4	7	43.8
Good	5	1	6.3
Very Good	6	2	12.5
Superior	7	1	6.3
	Total	16	100.0

Mean 4.188 Std dev 1.223 Valid cases 16

- -

BQ12 Advocacy and assertion practiced

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	3	18.8
Marginal	3	7	43.8
Acceptable	4	6	37.5
	Total	16	100.0

Mean 3.188 Std dev .750 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	3	18.8
Acceptable	4	8	50.0
Good	5	5	31.3
	Total	16	100.0

Mean 4.125 Std dev .719 Valid cases 16

BQ13 Crew-level after action reviews accomplished

Pretraining Results:

Rating	Value	Frequency	Percent
Poor	2	2	12.5
Marginal	3	6	37.5
Acceptable	4	4	25.0
Good	5	3	18.8
Very Good	6	1	6.3
	Total	16	100.0

Mean 3.688 Std dev 1.138 Valid cases 16

Post-training Results:

Rating	Value	Frequency	Percent
Marginal	3	2	12.5
Acceptable	4	10	62.5
Good	5	3	18.8
Very Good	6	1	6.3
	Total	16	100.0

Mean 4.188 Std dev .750 Valid cases 16

Appendix C

Grade Slip and ATM Frequency Tables

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM

For use of this form, see Aircrew Coordination Exportable Training Package and TC 1-212

PC _____ Date _____

PI _____

Instructor or evaluator will sign in the first unused block.

NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
1	CREW MISSION BRIEFING		27	EMERGENCY EGRESS	
2	VFR PLANNING		28	EMERGENCY PROCEDURES	
3	IFR FLIGHT PLANNING		29	HAND AND ARM SIGNALS	
4	DD FORM 365-4		30	FUEL SAMPLE	
5	DA FORM 5701-R		31	PASSENGER BRIEFING	
6	PREFLIGHT INSPECTION		32	INSTRUMENT TAKEOFF	
7	BEFORE-STARTING ENGINE THROUGH AIRCRAFT SHUTDOWN		33	RADIO NAVIGATION	
8	ALSE OPERATION		34	HOLDING PROCEDURES	
9	GROUND TAXI		35	UNUSUAL ATTITUDE RECOVERY	
10	HOVER POWER CHECK		36	RADIO COMMUNICATION PROCEDURES	
11	HOVERING FLIGHT		37	PROCEDURE FOR TWO-WAY RADIO FAILURE	
12	VMC TAKEOFF		38	NONPRECISION APPROACH	
13	TRAFFIC PATTERN FLIGHT		39	PRECISION APPROACH	
14	FUEL MANAGEMENT PROCEDURES		40	INADVERTENT IMC/VHIRP	
15	PILOTAGE AND DEAD RECKONING		41	COMMAND INSTRUMENT SYSTEM OPERATIONS	
16	ELECTRONIC-AIDED NAVIGATION		42	A/C SURVIVABILITY EQUIPMENT	
17	VMC APPROACH		43	MARK XII IFF SYSTEM	
18	ROLL-ON LANDING		44	CONFINED AREA OPERATIONS	
19	SLOPE OPERATIONS		45	PINNACLE OR RIDGELINE OPERATION	
20	AIRCRAFT REFUELING		46	FM RADIO HOMING	
21	POSTFLIGHT INSPECTION		47	EVASIVE MANEUVERS	
22	SIMULATED ENGINE FAILURE AT ALT		48	MULTIAIRCRAFT OPERATIONS	
23	SIMULATED ENGINE FAILURE AT		49	RAPPELLING OPERATIONS	
24	DEGRADED AFCS		50	INTERNAL RESCUE-HOIST OPERATIONS	
25	ECU LOCKOUT OPERATIONS		51	PARADROP OPERATIONS	
26	STABILATOR MALFUNCTION PROC		52	STABILITY OPERATIONS	

AIRCREW COORDINATION BASIC QUALITIES

1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR

AIRCREW COORDINATION TRAINING GRADE SLIP

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM					
NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
53	EXTERNAL LOAD OPERATIONS		79		
54	INTERNAL LOAD OPERATIONS		80		
55	AERIAL RADIO RELAY		81		
56	ACTIONS ON CONTACT		82		
◇57	TERRAIN FLIGHT MISSION PLANNING		83		
◇58	TERRAIN FLIGHT NAVIGATION		84		
◇59	TERRAIN FLIGHT		85		
60	WIRE OBSTACLES		86		
61	MASKING AND UNMASKING		87		
62	TERRAIN FLIGHT DECELERATION		88		
63	MAJOR US/ALLIED AND THREAT EQUIPMENT IDENTIFICATION		89		
64	TACTICAL COMMUNICATION PROCEDURES AND ECCM		90		
65	TACTICAL REPORT		91		
66	QUICK FIX MISSION		92		
67	FLAT TURN/VCALIBRATED FLIGHT		93		
68	ORAL EVALUATION		94		
69			95		
70			96		
71			97		
72			98		
73			NOTES:		
74			◇ NVD MANEUVER □ INSTRUMENT MANEUVER ○ STANDARDIZATION MANEUVER		
75					
76			ENTER S+, S, S-, OR U IN GRADE BLOCK. IF GRADE IS S- OR U DUE TO AIRCREW COORDINATION INCLUDE UP TO TWO BASIC QUALITY NUMBERS.		
77					
78			S- 2,5		

AIRCREW COORDINATION BASIC QUALITIES												
1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR
GRADE												

PAGE 2, AIRCREW COORDINATION TRAINING GRADE SLIP

BATTLE-ROSTERED CREW EVALUATION/TRAINING GRADE SLIP
For use of this form, see Aircraft ATM; the proponent agency is TRADOC

BATTLE-ROSTERED CREW EXAMINEES/ TRAINEES	NAME PC:	RANK
	PI:	
	NONRATED CREW MEMBERS DUTY SYMBOL NAME	RANK
	UNIT:	
EVALUATOR/ INSTRUCTOR	NAME	RANK
	UNIT:	

CREW DATA

TOTAL BATTLE-ROSTERED CREW HOURS	DATE DESIGNATED A BATTLE-ROSTERED CREW:
PURPOSE: EVALUATION/TRAINING	
TIME TODAY:	CUMULATIVE TIME:

TYPE AIRCRAFT: _____

CREW TASK 1 _____ D/N/NVD	CREW TASK 6 _____ D/N/NVD
CREW TASK 2 _____ D/N/NVD	CREW TASK 7 _____ D/N/NVD
CREW TASK 3 _____ D/N/NVD	CREW TASK 8 _____ D/N/NVD
CREW TASK 4 _____ D/N/NVD	CREW TASK 9 _____ D/N/NVD
CREW TASK 5 _____ D/N/NVD	CREW TASK 10 _____ D/N/NVD

DAY	NIGHT	WX	SIMULATOR	NVG	NVS

EVALUATOR/INSTRUCTOR RECOMMENDATIONS

- ☐ (ISSUE) (VALIDATE) CREW QUALIFICATIONS
- ☐ (SUSPEND) (REVOKE) CREW QUALIFICATIONS
- ☐ REQUIRES ADDITIONAL (FLIGHT) (ACADEMIC) (SIMULATION DEVICE) TRAINING
- ☐ SEE BACK FOR COMMENTS

I HAVE DEBRIEFED THE EXAMINEES/TRAINEES AND INFORMED THEM OF THEIR STATUS.
EVALUATOR'S/INSTRUCTOR'S SIGNATURE: _____

WE HAVE BEEN DEBRIEFED BY THE EVALUATOR/INSTRUCTOR AND UNDERSTAND OUR CURRENT STATUS.

PC'S SIGNATURE: _____

PI'S SIGNATURE: _____

NONRATED CREW MEMBER'S SIGNATURES: _____

_____

OVERALL GRADE FOR THIS FLIGHT IS: S U NA DATE:_____

DA FORM 7121-R, MAR 92

COMMENTS

PAGE 2, DA FORM 7121-R, MAR 92

APPENDIX C-2

ATM FREQUENCY TABLES

T1000 Crew Mission Briefing

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	5	31.3
S-	1	7	43.8
S	2	4	25.0
	Total	16	100.0

Mean .938 Std dev .772 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	2	12.5
S	2	10	62.5
S+	3	4	25.0
	Total	16	100.0

Mean 2.125 Std dev .619 Valid cases 16

- -

T1004 DA Form 5701-R(PPC)

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	3	18.8
S	2	11	68.8
S+	3	1	6.3
	Total	16	100.0

Mean 1.750 Std dev .683 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	1	6.3
S	2	13	81.3
S+	3	2	12.5
	Total	16	100.0

Mean 2.063 Std dev .443 Valid cases 16

T1007 Engine start-up, run-up, T/O, Land Checks

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	1	6.3
S	2	13	81.3
	Total	16	100.0

Mean 1.688 Std dev .704 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	3	18.8
S	2	11	68.8
S+	3	2	12.5
	Total	16	100.0

Mean 1.938 Std dev .574 Valid cases 16

- -

T1016 Hover Power Check

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	11	68.8
S-	1	5	31.3
	Total	16	100.0

Mean .313 Std dev .479 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	4	25.0
S	2	7	43.8
S+	3	3	18.8
	Total	16	100.0

Mean 1.688 Std dev .946 Valid cases 16

T1018 Perform VMC Takeoff

Pretraining Results:

Grade	Value	Frequency	Percent
S	2	16	100.0
	Total	16	100.0

Mean 2.000 Std dev .000 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S	2	13	81.3
S+	3	3	18.8
	Total	16	100.0

Mean 2.188 Std dev .403 Valid cases 16

- -

T1023 Fuel Management Procedures

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	13	81.3
S-	1	2	12.5
S	2	1	6.3
	Total	16	100.0

Mean .250 Std dev .577 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	4	25.0
S-	1	3	18.8
S	2	9	56.3
	Total	16	100.0

Mean 1.313 Std dev .873 Valid cases 16

T1028 VMC Approach

Pretraining Results:

Grade	Value	Frequency	Percent
S-	1	2	12.5
S	2	14	87.5
	Total	16	100.0

Mean 1.875 Std dev .342 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	2	12.5
S	2	12	75.0
S+	3	2	12.5
	Total	16	100.0

Mean 2.000 Std dev .516 Valid cases 16

- -

T1068 Emergency Procedures

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	5	31.3
S-	1	4	25.0
S	2	6	37.5
S+	3	1	6.3
	Total	16	100.0

Mean 1.188 Std dev .981 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	4	25.0
S	2	7	43.8
S+	3	3	18.8
	Total	16	100.0

Mean 1.688 Std dev .946 Valid cases 16

T1076 Perform Radio Navigation

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	2	12.5
S	2	12	75.0
S+	3	1	6.3
	Total	16	100.0

Mean 1.813 Std dev .655 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S	2	14	87.5
S+	3	2	12.5
	Total	16	100.0

Mean 2.125 Std dev .342 Valid cases 16

- -

T1081 Perform Nonprecision Approach

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	6	37.5
S-	1	3	18.8
S	2	5	31.3
S+	3	2	12.5
	Total	16	100.0

Mean 1.188 Std dev 1.109 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	6	37.5
S	2	6	37.5
S+	3	3	18.8
	Total	16	100.0

Mean 1.688 Std dev .873 Valid cases 16

T1083 Perform IMC Procedures (VHIRP)

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	3	18.8
S	2	7	43.8
S+	3	4	25.0
	Total	16	100.0

Mean	1.813	Std dev	.981	Valid cases	16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	2	12.5
S	2	8	50.0
S+	3	5	31.3
	Total	16	100.0

Mean	2.063	Std dev	.854	Valid cases	16

- -

T1095 Operate Aircraft Survivability Equipment

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	3	18.8
S	2	11	68.8
	Total	16	100.0

Mean	1.563	Std dev	.727	Valid cases	16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	1	6.3
S	2	14	87.5
S+	3	1	6.3
	Total	16	100.0

Mean	2.000	Std dev	.365	Valid cases	16

T2008 Evasive Maneuvers

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	4	25.0
S	2	10	62.5
	Total	16	100.0

Mean 1.500 Std dev .730 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	4	25.0
S	2	8	50.0
S+	3	3	18.8
	Total	16	100.0

Mean 1.813 Std dev .834 Valid cases 16

- -

T2009 Perform Multi A/C Operations

Pretraining Results:

Grade	Value	Frequency	Percent
S-	1	7	43.8
S	2	9	56.3
	Total	16	100.0

Mean 1.563 Std dev .512 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	4	25.0
S	2	10	62.5
S+	3	2	12.5
	Total	16	100.0

Mean 1.875 Std dev .619 Valid cases 16

T2016 Perform External Load Operations

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	5	31.3
S	2	5	31.3
S+	3	1	6.3
	.	3	18.8
	Total	16	100.0

Mean 1.385 Std dev .870 Valid cases 13

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	2	12.5
S	2	12	75.0
S+	3	2	12.5
	Total	16	100.0

Mean 2.000 Std dev .516 Valid cases 16

- -

T2078 Terrain Flight Mission Planning

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	10	62.5
S	2	5	31.3
	Total	16	100.0

Mean 1.250 Std dev .577 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	1	6.3
S	2	10	62.5
S+	3	5	31.3
	Total	16	100.0

Mean 2.250 Std dev .577 Valid cases 16

T2079 Terrain Flight Navigation

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	4	25.0
S-	1	9	56.3
S	2	3	18.8
	Total	16	100.0

Mean .938 Std dev .680 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	3	18.8
S	2	7	43.8
S+	3	5	31.3
	Total	16	100.0

Mean 2.000 Std dev .894 Valid cases 16

- -

T2081 Perform Terrain Flight

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	1	6.3
S-	1	1	6.3
S	2	14	87.5
	Total	16	100.0

Mean 1.813 Std dev .544 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
S-	1	1	6.3
S	2	14	87.5
S+	3	1	6.3
	Total	16	100.0

Mean 2.000 Std dev .365 Valid cases 16

OVGRD Overall Grade

Pretraining Results:

Grade	Value	Frequency	Percent
U	0	6	37.5
S-	1	8	50.0
S	2	2	12.5
	Total	16	100.0

Mean .750 Std dev .683 Valid cases 16

Post-training Results:

Grade	Value	Frequency	Percent
U	0	2	12.5
S-	1	2	12.5
S	2	9	56.3
S+	3	3	18.8
	Total	16	100.0

Mean 1.813 Std dev .911 Valid cases 16

Appendix D

Aircrew Coordination Training Validation Testbed
Exit Interviews

CREWMEMBER EXIT INTERVIEW

I. Course Administration

1. Was the classroom appropriately arranged for the number of students present?

Summary: Yes. General agreement that the classroom arrangement was comfortable and effective.

Specific Comments:
- Liked the horseshoe formation. It gave everyone a front row seat.
- Keep the horseshoe arrangement in the classroom.
- Improve horseshoe arrangement to allow more direct route to exits.
- The horseshoe arrangement is a good way to facilitate discussions.
- Instructor on end of horseshoe made class more formal. Prefer that the screen and instructor be more centered.
- The television screen wasn't placed very well.

Conclusion: Recommended that classrooms be arranged in a horseshoe or other formation that promotes intervisibility, discussion, and a seminar environment.

2. Was the number of students in the class about the right size for this training?

Summary: Yes. General agreement.

Specific Comments:
- Five to eight crews was about right. No more than eight crews.
- Could have fewer but not more crews in a class.
- Eight crew class size helped have better discussions.
- More crews would take more time to teach.

Conclusion: Recommended that the student course class size be limited to 16 rated and/or nonrated crewmembers.

3. Did the videotaping of the classroom instruction detract from or enhance the classroom environment? If so, how?

Summary: Mixed opinion.

Specific Comments:
- At first, people were reluctant to discuss personal experiences and actual incidents but eventually they opened up.
- Would get more discussions without the camera.
- It enhanced research but inhibited some comments and may have inhibited some incident sharing.
- At first, it was intimidating but eventually, it didn't make a difference.
- Enhanced things for the [research] test team but it inhibited us.
- Helped clean up language.
- It probably decreased the "informal" language a bit.

Conclusions:
- Videotaping classroom instruction tends to initially distract and generally inhibit open discussion.
- Recommended that classroom instruction not be videotaped except for instructor methods of instruction (MOI) training as required.

4. Was the instructional staff properly prepared to conduct the course? If not prepared, what deficiencies did you note?

Summary: Yes. General agreement that instructors were well prepared given the limited time available.

Specific Comments:

Strengths:
- IPs are better, more accustomed to teaching.
- Good to have UTs and IPs involved in team teaching the course, that way UTs receive a training benefit too.
- IPs seemed to be more accustomed to instructing compared to UTs. IPs gave examples, UTs mostly read from the book.
- All instructors followed the course outline fairly closely.
- UTs and IPs did a good job given the short preparation time--they were "believers" in the system.
- Cross training of crews between units was good as a reinforcing technique.
- CW3 Lear is a natural instructor; was always prepared; exhibited a relaxed style; balanced humor and seriousness.
- It's good to use our own instructors in the training.

Weaknesses:
- Tendency to read from the instructor's outline and slides. Some instructors didn't seem to have enough background and experience.
- Some questions, for example, CRL progression and battle rostering, had to be answered by the Fort Rucker trainer team [CW4 Sheehan and Mr. Pawlik].
- I thought that their training should have been more in-depth. They needed more time to prepare.

Conclusions:
- Recommended that unit instructor pilots implement crew coordination training.
- IPs must prepare crew coordination qualified unit trainers to assist them in team teaching unit crews. IPs are the principal instructors within IP-UT instructor teams and instill a positive attitude toward crew coordination.
- Instructors need at least 2 hours of preparation time for every 1 hour of classroom instruction.

5. Were the facilities adequate during the simulator phase of training? If not, what was unsatisfactory?

Summary: Mixed opinion.

Specific Comments:
- Some of the briefing rooms were too small to spread out maps and flight planning materials.
- Facilities were excellent compared to what is provided in the field for mission planning.
- It was good to have separate rooms for premission planning and AAR.
- Two crews planning together for training missions was not a problem.
- Should reduce the size of the maps and laminate them so can use permanent markers. Water-based markers rub off from map case covers.
- Have coffee available during planning and after- action review.
- One military and one civilian IO didn't role play the crew chief position very well. Many SOP items and expected crew chief actions were not provided.
- It would be better to use unit IOs who are more familiar with unit SOPs and expected duties. Unit IOs normally go to the simulator with the crews.
- Simulator computer crashes were distracting and frustrating.

Conclusions:
- Recommended that premission planning and after-action review activities be kept separate.
- Use the flight planning materials and administrative resources normally available in the unit and installation flight simulator facility.
- Emphasize the need for military and civilian flight simulator IOs to role play (for example, other crewmembers, other aircraft, and tactical units) during simulator missions. Provide IO scripts for scenario events and required IO-crew interaction.

6. What changes do you recommend to improve the administration of future courses?

Summary: General agreement on the types of changes needed to improve the course.

Specific Comments:

Schedule:
- See related responses at item II, 16.
- Consider increasing the number of hours from 18 to 20 and scheduling the course over five half days instead of three full days. This would spread out the instruction and allow more time for understanding.
- Offer full-day and half-day scheduling options. Some units want crews to perform other duties during training.
- Provide more advanced notice and information about the course (for example, the requirement for tactical missions in the flight simulator).
- Explore opportunities to shorten the course. Some topics seem to be common sense.
- Conduct the course off-post if using the full-day schedule.
- Obtain command emphasis to ensure that crews are available for training without competing demands on their time.
- Block the unit training schedule well in advance.

Crew Composition:
- Consider mixing and matching crews throughout the course to promote crew coordination standardization rather than familiarization.
- Mix crews for the training missions. Match the crews per the unit's battle roster for the evaluation missions.
- Explore the difference in performance between non-battle rostered crews with crew coordination training and battle rostered crews without crew coordination training.

Types of Missions:
- Integrate an actual aircraft flight into the training--maybe not the final ride. Artificial nature of the flight simulator can be distracting and introduce a simulator mindset (e.g., should I really set the exterior or anticollision lights or not?).
- Consider adding a night flight in the actual aircraft or simulator--with battle-rostered crews only. Prefer aircraft over simulator for NVD missions.

Academics:
- Consider adding a review of MOI techniques for the UTs.
- IPs could benefit from Instructor Training Course experience to improve their classroom technique.
- Need to introduce crew coordination in a top-down fashion within the units. Start with the commander.
- Would be good to have a UT dedicated to teaching crew coordination.
- There needs to be a program to "qualify" instructors to teach this course.
- Add more "key points" in the student outline. Spent too much time filling in the blanks while following the lesson plan.

Conclusions:
- Included full-day and half-day classroom training schedule options in the course.
- Recommended that units use the full-day training option with students placed on excused duty status. If excused duty status is not possible, then recommended the half-day training option for five days.
- Recommended that crew coordination training be placed on the training schedule with the same command emphasis as field training exercises.
- Included an option to mix crewmembers rather than rigid battle-roster for training missions. Emphasized that crew coordination training is not learning how to operate with a particular crewmember; it's a set of standardized operating procedures/techniques to be used in any situation.
- Expanded the course to include a pre-training mission and a course completion evaluation mission in the simulator or aircraft.
- Modified the course to allow for local consideration of a fourth training mission with options for NVD, aircraft instead of simulator, and/or mixing crewmembers.
- Provided student read-ahead materials.
- Included a review of MOI principles in the Trainer Course.
- Expanded the Student Handout to include abbreviated talking points.
- Recommended that if units decide to designate a unit trainer for crew coordination, that such appointments clearly specify that crew coordination is an IP program.

II. Course Structure

1. Was the course well organized in terms of subject flow?

Summary: Mixed opinion. See comments and conclusions for items a through j.

a. overview?

Specific Comment: It seemed to me that we spent too much time on the overview.

b. history?

Specific Comments:
- Shorten the amount of time spent on this.
- It's interesting but don't spend too much time on it.

c. structure of the course?

Specific Comments:
- The whole course seemed like everything was a shot gun effect. Some things seemed scattered and not related, and other topics seemed redundant.
- It was hard to follow material without insight into how the topics were related.
- Course structure information is of little value and should be covered quickly. Need to get to the heart of the course quickly.
- Good use of a video segment to drive home an image of why I need to be in this class. That got my attention.
- Need to set the course up to help crews who are flying together for the first time.

Conclusion: Modified the course to shorten the introduction and introduce the crosswalk chart of related crew coordination topics as a means to get to the heart of the instruction early.

d. crew coordination model?

Specific Comments:
- Spent too much time on models and the logo. Wanted to get going faster.
- The cover logo is not the same as the crew coordination model--found this to be confusing.
- I thought the logo and the model were good. Our instructors didn't overuse them.
- Good. Easy to understand. Clear and understandable.
- The term "models" was used inconsistently throughout the course.

e. crew coordination elements?
No problems or comments.

f. Basic Qualities?

Specific Comments:
- Hard to remember 13 Basic Qualities. Alright as long as not required to memorize.
- Made you think of things that you normally take for granted when you fly with a new crewmember.
- The BQs are important by themselves, but the models and so forth didn't help me.

g. crew coordination objectives?
No problems or comments.

h. definition, discussion, effectiveness factors, and examples of Basic Qualities?

Summary: Mixed opinion.

Specific Comments:
- Emphasizing the acceptable level as the initial training objective made sense.
- It was good that the scales provided for an "acceptable" performance level, rather than just forcing everyone to excel.
- Showed a lot of difference between superior and very poor ratings.
- Once fielded, should strive for superior instead of acceptable performance levels.
- Think should emphasize superior. Disagree. Acceptable is simple, direct, and doable; superior may take too much initial training time.
- Train to acceptable with sights on superior.
- Work toward superior in unit continuation training.
- Emphasize the superior more. It's important to have high standards.
- Highlight the superior factors in the classroom. Emphasize the acceptable performance level.

Conclusion: Established the acceptable level of performance as the training goal for *initial* crew coordination training.

i. phase review?

Specific Comments:
- See related responses at item III,1.
- If there were a written test at the end of the course, then we would have paid more attention in class.
- Consider adding a written test on the academics.

Conclusion: Added sample oral examination questions for evaluator debriefings that could be used as test questions for the academic phase.

j. hands-on simulator application?

Specific Comments:
- See related responses at item III,2.
- A brief introduction is needed prior to the first simulator evaluation flight--had no idea what to expect that first ride.
- Uncertainty over the first evaluation ride created a negative attitude toward the course.
- First evaluation ride had a positive effect on learning during the classroom. You can draw on the experience in class.
- After the first ride I could really see the difference. Its a psychological advantage to fail so badly, then improve so much.
- Need both classroom and simulator. Classroom itself is not enough.
- Simulator allows for various problems and stressful situations to be thrown at you.
- Simulator training, despite its lack of realism, helps in training for actual aircraft.
- Simulator (lacking GPS) forces you back to basic navigation techniques.
- The simulator is valuable, but we need help to make sure we do it in the aircraft. Use no-notice UT rides to reinforce crew coordination in the aircraft.

Conclusions:
- Both classroom instruction and simulator or aircraft hands-on application are required in the course.
- Incorporated the pre-training mission into the course because it helps students relate to the subject matter and to focus on important points in the classroom instruction. Incorporated read-aheads to orient students to the course.

2. Were the subjects presented applicable to your job as an Army aviator?

Summary: Yes. General agreement with one exception.

Specific Comment: Flight standards should provide units with the correct priorities for mission planning tasks, rather than having the crews develop them.

Conclusion: No action recommended due to the range of METT-T considerations across units.

3. **Were the subjects well developed so that you are confident that you understand the material?**

Summary: Yes. General agreement.

Specific Comments:
- May have developed some subjects too much. Some topics seem repetitive.
- Maybe too much time was spent on some examples.
- Reduce the amount of lecture and substitute class analysis of case studies.
- Develop more practical exercises for student involvement.

Conclusion: Expanded the current practical exercises to include tactical examples.

4. **Was the interrelationship between Crew Coordination Elements in the ATM Tasks, the Basic Qualities, and the Crew Coordination Objectives clearly established?**

Summary: Mixed opinion. Majority agreed that the crosswalk chart would be a benefit.

Specific Comments:
- Still had difficulty at the end of the course relating objectives, qualities, etc.
- Need to provide students with a crosswalk chart showing relationships among objectives, qualities, and elements [given only to IPs]--provide it two-thirds of the way through the course or at the end.
- The crosswalk chart ties it all together [students had to do this on their own or remain confused]--blow it up as a wall chart to be displayed throughout the course.
- Hard to follow various numbers of objectives, qualities, etc.
- It's a bit too many numbers--6 elements, 13 BQs, 5 CCOs.
- Reached a saturation point. Stress only what is important in the cockpit and forget the rest (e.g., objectives).
- Crosswalk chart would be good to have as a handout or hang it up in class so we could use it all the time.
- Suggest using the crosswalk chart instead of the "target" model as a training aid.
- The relationships were very clearly established, but at the user level, the relationships are not relevant and would not affect the way you fly.
- Basic Qualities are important, but not the other relationships to elements, ATM tasks, etc.

Conclusion: Need to provide the crosswalk chart during class to keep students on track with the instruction. Included the crosswalk chart in the Student Handout materials.

5. Were the Basic Qualities well defined and explained?

Summary: Yes. General agreement.

Specific Comments:
- The Basic Qualities made you think about things you might otherwise take for granted.
- Could combine some Basic Qualities that appear to overlap one another or relate to the same end.
- Thirteen is a good start point for branching out; there is a tendency for BQs to intersect.
- Some of them overlap but it depends on the situation; I can see how they are interdependent.
- They were good. There was the right amount of them.
- I'm not sure why the BQ of cross-monitor is the same as the CCO of cross-monitor. They seem about the same.
- Some seem to fuse together (for example, information sought and information offered).
- They seemed fine. Just about the right number.
- Well thought out. Some overlap, but just the right amount.

Conclusion: Emphasized the importance of Basic Qualities to teaching and evaluating crew coordination.

6. Were the effectiveness [rating] factors clearly linked to the Basic Qualities?

Summary: Mixed opinion.

Specific Comments:
- Yes, they seemed to be.
- Effectiveness factors were not covered thoroughly in class.
- I thought that some of the superior descriptions were not doable. They require too much training time.
- We needed more time to understand the effectiveness factors. We just read them in class and went on. More discussion is necessary.

Conclusions:
- The terms effectiveness factors and rating factors were used interchangeably during course development and testing.
- Modified course materials to consistently refer to these factors as "rating factors" and emphasized their relationship to the Basic Qualities and behavioral anchored ratings that they support.

7. **Were the Crew Coordination Objectives well demonstrated in terms of case studies?**

Summary: Yes. General agreement.

Specific Comments:
- Need some UH-60 Broken Wing award examples.
- They were pretty realistic and made you think about similar situations.
- Case studies were good. They got the class more involved in discussing situations similar to the cases. Should call on more people to participate in discussions.
- Should have more discussion time for case studies.
- Could use a greater number and more varied case studies.
- Emphasize emergency procedures more to illustrate the role of each crewmember. We need to learn how to use our crewmembers better in emergency situations.
- Need a case for decision techniques.
- Develop case studies with different endings due to the effects of crew coordination.

Conclusions:
- Recommended that the course proponent and instructors continuously improve the course by adding both positive and negative case study examples.
- Identified candidate segments from the testbed missions that support development of "branching" scenarios or that could be used to enrich the video case studies.

8. **Were the Crew Coordination Objectives well demonstrated in terms of video segments?**

Summary: Yes. General agreement.

Specific Comments:
- They were good. Crew coordination could apply to almost any accident.
- They seemed to really emphasize the importance of crew coordination (e.g., fast rope example).
- Could benefit from videos that could be stopped for questions and have branching to different endings (video comparisons of good and bad actions).
- Need more video segments.
- Video taping situations recreated in the simulator is a good approach.
- Question whether the CH-54 miscalculation of gross weight was a crew coordination error: It was more an individual error. [Discussed need for cross monitoring.]
- I think the videos should be actual or reenactments in the aircraft. Reconstructions in the simulator are second best.
- Need more crew chief oriented videos. The fast rope video would be good for crew chiefs.

Conclusions:
- The Army should use in-house resources to develop video segments by recreating cases in the simulator or aircraft.
- Recommended specific segments from the testbed videotapes that have crewmember's consent for addition to the course.
- Stress the crew error aspect of the CH-54 accident video segment.

9. **Was there about the right mix of video and written case studies to help you understand the Basic Qualities and Crew Coordination Objectives?**

Summary: Need more videos.

Specific Comments:
- Video examples really assist in illustrating the various Basic Qualities--the more video segments the better.
- The video and audio tapes really helped. It didn't matter that the examples were from different aircraft.
- It would be good to read a case study, then see it on the video. That would be helpful to better understand everything that is going on.
- It's good to read and then see; then you get a real feel for it.

Conclusion: Recommend that additional videos be developed to visually illustrate the case studies.

10. **Was the Student Handout satisfactory?**

Summary: Mixed opinion. See comments and conclusions for items a through c.

a. **Did it assist you in following the instructor's presentation?**

Specific Comments:
- Yes, but make it a separate book that can be written in--didn't like having to flip back and forth in the same book.
- Sometimes I got confused about which section was which.
- Would have preferred to have the handout separate from the book. That way it would be easier to get to the various sections in the book and still keep my place in the course presentation.
- Found it hard to follow--got lost as to where the instructor was at in a particular discussion versus the reference in the handout.

- Not always; unable to track with instructors comments.
- Too much information to listen and write.

Conclusions:
- Modified the Instructor's Guide to indicate where the information is located in the Student Handout.
- Encouraged instructors through lesson plan marginal data to routinely announce the location of transitions and main points in the Student Handout.
- Produced the Student Handout outline for note taking so that it can be separated from the other student material.

b. Was there sufficient white space for taking notes?

Specific Comments:
- Yes, there was plenty of room to write in.
- There was more white space than needed. Less space would do.

Conclusion: Reduced the requirement and the amount of space for note taking.

c. Should any other items be added?

Specific Comments:
- There is too much information to listen and write.
- Student Handout needs more information bullets, especially for points that need to be emphasized.
- We should have more in information in front of us. Then we wouldn't need to take so many notes and could listen more.
- Emphasize note taking. If everything is written down, then maybe we would only be reading the material instead of paying attention.
- Include the crosswalk chart.

Conclusion: Added details on main points and key talking points from the Instructor's Guide and included the crosswalk chart.

11. Did you read any of the articles in the Reference Book? If yes, which ones and were they informative?

Summary: Mixed response.

Specific Comments:
- Good reference material. Helpful.
- The Navy flight surgeon article on stress, the male-female differences in communication article, and MG Robinson's article were especially good.
- Read all of them but don't remember them well.

- Case studies and *Flightfax* readings were more interesting.
- Some were scanned, but not all. My night flying schedule was too demanding.
- Only read the articles referenced in class. Didn't have enough time to read any other articles.
- The more relevant the article is to the class, the better chance there is that I would read it.

Conclusions:
- Reviewed all articles in the Background Reading section to ensure relevancy, interest, and brevity.
- Included a brief abstract for each article in the table of contents.
- Added reading assignments for discussion in the next day's class to the Trainer and Instructor's Guides.

12. Was the mission planning and rehearsal practical exercise helpful? How could it be improved?

Summary: Mixed opinion.

Specific Comments:
- It was good; a bit frustrating, but good. It's hard to put all those things in sequence. [Majority considered 35 items too many.]
- Hard to do in a group because of different opinions. [Others found group discussion to be useful in discovering rationale for priorities.]
- Need to allow more discussion of different views on priorities--this caused some frustration because time was not allowed to form a consensus.
- Seemed incomplete; need to have more follow-up on why this was important.
- Have to allow for different planning sequences for different missions--no right answer for all missions. [Groups debated the need for a "school solution" or right answer.]
- Need a model of basic sequence and priorities for mission planning.
- Valuable to the individual to think about priorities--artificial in the sense that individuals usually do not plan by themselves; they plan as a team.
- Could be improved by collapsing the 35 items into 10 to 15 major headings--planning and map marking can be considered the same thing.
- I learned what all the planning considerations are. Usually, being pilot of a flight, I only do a part of the list. Now I have the big picture.

- Not needed after the first flight with a crewmember, these things always get worked out.
- Should administer the exercise to crews within the same unit because each unit plans differently.

Conclusion: Consolidated the planning items and recommended that the instructors allow no more than 2 crews (4 to 6 persons) as work groups during the exercise.

13. Was the communications practical exercise helpful? How could it be improved?

Summary: Mixed opinion.

Specific Comments:
- Good exercise, but need a more tactical example.
- Emphasize the use of standard terminology in the exercise.
- Include tactical examples like LZ, PZ, BP, and firing positions.
- Require a description of something tactical with no communications feedback.
- Use the basic figure, then go on to a tactical example.

Conclusion: Included tactical examples for instructors to supplement the basic geometric figure.

14. Did you complete the Hazardous Thought Pattern exercise? If not, do you plan to do so? If you did, was it helpful?

Summary: Mixed opinion.

Specific Comments:
- Few individuals did the exercise.
- Many disliked the forced choice nature of the test--difficult to select a response.
- Thought it was very good, useful, and should be part of the course.
- Consider using the Hazardous Attitude Survey.

Conclusion: Reworded directions to increase respondent comfort with the forced choice nature of the exercise and included notes in the Instructor's Guide to encourage its use during the course.

15. Did you complete the Stress Management exercise? If not, do you plan to do so? If you did, was it helpful?

Summary: No opinion.

Specific Comments:
- Few completed the exercise.
- One crewmember indicated that he planned to complete it.

Conclusion: Added the stress management exercise as an optional in-class practical exercise and included it in the outside reading assignments.

16. Was the course the right length to teach crew coordination? If not, what adjustments are necessary?

Summary: Mixed opinion. Generally favorable.

Specific Comments:
- Course is about the right length for initial training.
- Consider adding another day and conducting the classroom training half-days in the morning only.
- Introduction could be shortened to two hours since most of the material was repeated later on.
- The course seemed too long for a crew who had flown together a long time. [Other crews debated this where there was not familiarity.]
- Reduce the number of hours if possible. Parts seemed repetitive. Condense some discussion.

Conclusion: Provided options in the Instructor's Guide for half-day scheduling of the classroom instruction phase.

III. Flight Simulator (hands on)

1. Was the purpose of the simulator phase explained?

Summary: Yes. General agreement.

Specific Comments:
- Yes. Completely understandable.
- It's an important part of the course, so I knew what it was for. Makes perfect sense.
- It was clear that our end of course evaluation was the final simulator mission.

2. Was the hands-on phase necessary to effectively teach crew coordination principles?

Yes. Strong agreement.

Specific Comments:
- Absolutely essential.
- Definitely needed as part of the course. Helps reinforce classroom instruction.
- New techniques should be practiced in the safety of the simulator.
- Necessary demonstration of crew coordination principles. Puts principles into action. This way I really learned.
- The simulator is valuable, but training in an actual aircraft would allow crew chief participation.
- You don't worry about some problems as much in the simulator, as compared to flying the actual aircraft.
- Pre-training evaluation mission may be negatively biased because some of the crews were not the regular battle-rostered crews [performance in aircraft would have been better].

Conclusion: Provided options in the Instructor's Guide for an aircraft-based training or evaluation mission.

3. Was the "crawl-walk-run" approach to the training and evaluation rides effective? More rides needed? Adequate number of rides? Too many rides?

Summary: Mixed opinion on the crawl-walk-run approach and the number of missions.

Specific Comments:
- Pre-training evaluation mission was important to get our attention, helped us see the value of the course, and motivated us to improve.

- The baseline evaluation mission shouldn't be too difficult or it can create hard feelings. I didn't appreciate the 19° magnetic variation surprise.
- I didn't notice much difference in the way the instructor interacted during the simulator missions. I don't think our crew really got the crawl-walk-run training approach.
- Instructors should be more aggressive in pointing out errors and weaknesses.
- Training rides were too check-ride oriented with too little emphasis on crew coordination principles.
- The number of simulator missions was "just right" to provide a good foundation.
- Need more simulator missions. We continued to improve with each simulator flight--more is better within time constraints.
- Not enough missions to obtain CRL1.
- It would help to have a pre-training practice tactical mission. We usually don't fly tactics in the simulator.
- Keep pre-training evaluation for comparison with training missions and the end of course evaluation mission.

Conclusions:
- Expanded the Instructor Guide discussion of instructor and evaluator actions during simulator or flight missions (i.e., emphasized the learning and not the evaluation aspects of the training missions).
- Added the pre-training evaluation mission to the course.

4. Did you have enough time during the hands-on periods; that is, pre-mission planning and rehearsal, mission execution, and after-action review?

Summary: Mixed opinion.

Specific Comments:
- Not enough time for the pre-training evaluation mission. We didn't know what to expect.
- There was adequate time after we had the classroom instruction as we became more efficient at planning.
- Insufficient time to plan and rehearse such a complex mission. It would take a day to plan these types of missions in the unit.
- There is no need for IPs to read the OPORD to the crew. Instructor or evaluator should provide an operations officer mission overview and be available to answer questions.
- Some aspects of the mission briefing, like weather, were a waste of time. Better to just give the crew a copy of the briefing and be available to answer questions.

Conclusion: Emphasized the instructor and evaluator's role as operations officer and use of the air mission briefing in the Instructor Guide.

5. **You participated in four simulator rides during the testbed. What did you think about these rides in terms of whether they reflect the types of missions you fly? In terms of the level of difficulty?**

Summary: General agreement in mission realism and difficulty.

Specific Comments:
- Scenarios were realistic and representative of daytime METL.
- Covered unit missions except night conditions.
- Missions were challenging, but about right. Crew coordination skills improved during the course and this increased confidence.
- Consider adding a NVD mission in the aircraft or simulator. Prefer use of the aircraft due to insufficient light contrast in the simulator.
- Consider having crews locate themselves after being placed on random terrain.

Conclusion: Included an option in the Instructor's Guide to provide for an additional training mission to address NVD, actual aircraft, and/or mixing crewmembers.

6. **Do you feel that the use of the videotape of your crew's simulator flight during the instructor debriefing was a good training technique? Why?**

Summary: Yes. Strong agreement.

Specific Comments:
- Yes, absolutely necessary.
- I probably learned more from the videotape review. Feedback on actual performance is the best part of the course.
- Helps you remember what happened, check problem areas, and settle disagreements.
- Allows you to recognize your own weaknesses and strengths, recognize mind lapses, identify own mistakes, review own performance, and tie the training together.
- Need tape counters and mission time marks to locate actions on the videotape for review. [These features were present in the testbed equipment. The aviator wants them generally available.]

Conclusion: Emphasized in the Instructor's Guide the importance of reviewing videotapes during mission debriefings.

IV. General Observations

1. What is your overall impression of the adequacy of the aircrew coordination training provided? Do you have any recommendations for improvement?

Summary: Course is fully adequate. General agreement.

Specific Comments:
- It was an excellent course. Glad to see the emphasis on safety.
- I'm 100% for this program. It will save lives and aircraft. It may well save my life one day.
- I thought some of the material was common sense but it is needed to institutionalize common practices and define techniques. Makes everyone speak up and fly as a crew.
- Some individuals and crews were already practicing crew coordination skills but didn't realize it. Now we know what to add and where to improve.
- Should have non-rated crewmembers attend the training. It would improve their assertiveness and acceptance by rated crewmembers. Crews would communicate better and emphasize the importance of the total crew.
- Consider scheduling back-to-back simulator missions instead of the day or two break between simulator periods.
- Explore the benefit of interspersing and/or alternating academics and simulator sessions.
- I would have liked to be able to keep the tapes and review them when I had more time at home.
- I felt that this was a crash course. I need more time to try it out, reflect, and discuss it with IPs.
- Orient the course for unfamiliar crews rather than using it to progress aviators to CRL-1 level.
- Videotapes are a must for this training. Cameras should be installed in simulators for crew coordination training.

Conclusions:
- Emphasized the importance of including non-rated crewmembers in the course.
- Recommended that all flight simulators and designated aircraft be equipped with video cameras to support crew coordination training.

2. What is your overall impression of the conduct of the aircrew coordination evaluations? Do you have any recommendations for improvement?

Summary: Evaluations were consistent with current practices. General agreement.

Specific Comments:
- It is good to evaluate the crew instead of an individual aviator flying with an IP.
- Evaluations conducted from the jump seat were effective.
- Evaluators in the role of crewmember must be considered part of the crew workload.
- It is beneficial when IPs instruct as they evaluate.
- Simulator console operator communications can lead to crew error, especially during instrument conditions.
- Need to place more emphasis on reviewing the principles taught in the classroom instead of emphasizing evaluation.
- Evaluation debriefs tended to be checkride oriented at first; then they became more instructional.
- Consider conducting one evaluation in the actual aircraft.
- Evaluate unit continuation training, too.

Conclusions:
- Emphasized the instructional nature of evaluations and debriefings.
- Emphasized the liberal use of unit SOP terms (e.g., key words to prevent gross misorientation during terrain flight navigation).

3. **Do you personally feel that you are now better prepared to perform as an Army aviation crewmember? Why?**

Summary: Yes. Strong agreement.

Specific Comments:
- I'm a lot less intimidated. I realize that I have a lot to contribute as a crewmember.
- Made me think more, even with crewmembers that I have flown with before.
- Helps assertiveness among crewmembers. Communication is better.
- Have used crew coordination principles already on the flight line. Crew briefings are greatly improved.
- Helped with workload management and workload awareness.
- Increased awareness of the need for open communication in the cockpit.
- I sequence and time activities better. Got me out of some bad habits.
- More comfortable in the cockpit. Feel like more of a team member.
- Much of the course material was subconscious before, but now I understand why I do things better.
- I know what I do well and not so well, and divide workload with other crewmembers accordingly.

Conclusion: Emphasized that the course implements the Army's philosophical shift from individual aviators to crews and that students should expect to be better crewmembers after the training.

4. **Would you recommend that this course be attended by every Army aviator? Why?**

Summary: Yes. Strong agreement.

Specific Comments:
- Should include non-rated crewmembers; for example, crew chiefs, door gunners, ground crews to standardize the entire crew.
- Include ATC personnel.
- Integrate the course into IERW and other institutional training.

Conclusions:
- Emphasized that course attendees include non-rated crewmembers.
- Recommended crew coordination familiarization training for ground crews.

5. **If this training package is fielded Army-wide, should there be a system to track testbed participants in longitudinal studies of the Army's crew coordination program?**

Summary: Yes. General agreement.

Specific Comments:
- Could be used to refine the crew coordination program and improve the training course.
- Track to determine the length of time needed to achieve superior performance level.

Conclusion: Recommended that the class roster of testbed participant instructors and aircrews be retained to follow up crew coordination policy, program, and training progress over time.

6. **What effect has participation in this project had on you personally?**

Summary: General agreement on positive effect.

Specific Comments:
- Communication has improved. Improved the way I brief and discuss missions.
- Changed mindset from single pilot to team concept.

- Increased confidence in self and crew.
- Understand the importance of planning.
- Course will probably save my life in the future, particularly the 2-challenge rule.
- Changed my mind about the worth of simulator missions, especially the need to brief and rehearse within available time.
- Raised awareness level of what's going on in the cockpit.
- Caused serious evaluation of own habits and self as a crewmember.
- More detailed thinking. More professional in speech and actions.
- Able to sort and manage tasks.
- Ask more questions and get more involved in flight.
- Changed from cockpit dictator to crewmember.
- Applied crew coordination principles to other courses and at home.
- More open in the cockpit. Don't assume as much.

Conclusion: Recommended that the letter of transmittal that accompanies the exportable training course to units in the field convey the positive effect the course had on testbed participants.

7. Do you have any questions or concerns that you would like to ask or convey to the crew coordination project staff?

Summary: Open discussion surfaced both questions and concerns.

Specific Comments:
- When will the training package be fielded? 1993.
- What will the training program cost the Army? [Estimate of $4M.] We could save one aircraft and this course would more than pay for itself.
- Battle rostering and crew coordination should be considered separately.
- Introduce more variability into the missions to avoid activity patterns like IMC always the last segment.

EVALUATOR AND TRAINER EXIT INTERVIEW

I. Course of Instruction

1. Has adequate time (or too much time) been allocated for each segment of the course? In answering this question, consider both the Trainer Course and the Student Course.

Summary: General agreement that the amount of time for the Trainer Course and the Student Course is adequate and that alternative scheduling options and command emphasis are needed for both courses.

Specific Comments:
- I think that there was adequate time--don't go with any less. Class effectiveness and use of class time is dependent on how much interaction there is within the group.
- If time constraints are not a big problem, the course academics should run four hours each morning. That way, the crews can do their required work in the afternoon and instructors can prepare the next day's classes. The half-day schedule would be preferable for commanders.
- Full days or TDY would work best. If we schedule only half days, the crews will continue to have additional duties and be expected to fly at night. Crews should be scheduled so there are no conflicts.
- Put the course on the training schedule so that the company is committed for three days. To do this, the emphasis has to come from the brigade or the division.
- Commanders should be the first to attend the course to gain their support. Positive command emphasis would make the instructor's job easier.
- Need more classroom time to cover scenario development including information on IO scripts.

Conclusions:
- Included full-day and half-day training schedule options in the course.
- Recommended that units use the full-day training option with students placed on excused duty status. If excused duty status is not possible, then recommended the half-day training option.
- Recommended that crew coordination training be placed on the training schedule with the same command emphasis as field training exercises.
- Introduced evaluation and scenario development activities in the Trainer Course to cover lessons learned and IO script information.

2. **Was the number of video segment case studies adequate to teach the 13 Basic Qualities?**

Summary: Yes. General agreement.

Specific Comments:
- Yes. I thought they were very effective. I don't think any more are needed. You could easily pull the Basic Qualities from the segments with a little thought.
- The case studies and video segments covered more than one BQ but it was easy for the crews to see how the BQs fit in. They were good choices.
- Video segments thoroughly enhanced class participation. The more the better.
- Need a video segment for after action review (AAR).
- Strive to include videos that represent all platforms. The UH-1 rapelling accident was very effective.
- See related responses at item I, 3.

Conclusion: Recommended specific after-action review segments from the testbed videotapes that have crewmember's consent for addition to the course.

3. **Were the written case studies effective in emphasizing teaching points? If yes, was the number of written case studies adequate to teach the 13 Basic Qualities?**

Summary: Yes. General agreement.

Specific Comments:
- Yes. They were very effective. Videotapes are better but the written case studies worked too.
- Instructors end up using both the videos and the written case studies together.
- Written case studies allow the instructor to draw out both positive and negative examples during discussion.
- Yes. Each case study covered more than one Basic Quality and it was easy for instructors to tie them together. The cases were good examples.
- There are definitely enough cases to teach the course. Instructors should add their own cases from *Flightfax* and other sources to keep the course current.
- Consider adding a short introduction to the case studies so that the students will know what to look for and what went wrong. I think the aviators need to get more of an idea of the case study's focus.
- Need a written case study for AAR.

Conclusions:
- Recommended the use of the UH-60 Fast Rope case study and video segment as the example for teaching the AAR instructional segment.
- Emphasized the instructor's responsibility to maintain the course by adding up-to-date case study materials.

4. Has the course tied crew coordination principles and techniques adequately to the ATMs?

Summary: Yes. General agreement.

Specific Comments:
- Yes. It was done very well. The ATM standards state, "correctly perform Crew Coordination." With this course, you know how to correctly perform the crew coordination component of the ATM tasks.
- The relationships really came together after two simulator missions.
- I am concerned that TC 1-210 and TC 1-212 will be implemented without the benefit of this training. The Crew Coordination program should become official in order to effectively implement the TCs.
- See related responses at items I, 2 and 3 and II, 5.

Conclusion: The course is effective and necessary to implement the new training circulars.

5. How many simulator sessions are required to achieve crew coordination proficiency?

Summary: General agreement on four to five simulator missions to implement the Army's crawl-walk-run training philosophy.

Specific Comments:
- I think that four missions are necessary. The first two missions should be assisted, then the third should be hands-off. I believe this would implement the crawl-walk-run approach and result in improved evaluation rides.
- It should be four with three training (two assisted, one hands-off) and then an evaluation.
- If I really had my preference, we would have five missions and include the baseline for teaching purposes.
- Minimum of three, maximum of five.
- Five missions as follows:
  - baseline evaluation.
  - three training (crawl, walk, run)
  - final evaluation.

- Third mission should be under more stressful NVD conditions. [Some disagreement that this might be too hard.]
- Use the same trainer for training missions; switch evaluators from baseline to final evaluations.
- Don't forget crawl-walk-run. If training is too rushed, nothing will be reinforced. Two training flights are very important to the understanding and reinforcement of the classroom instruction.

Conclusions:
- Expanded the course to include a pre-training mission and a course completion evaluation mission in the simulator or aircraft.
- Modified the course to allow for local consideration of an additional training mission with options for NVD, aircraft instead of simulator, and/or mixing crewmembers.

6. **What effect, if any, did the pre-training evaluation mission in the simulator have on the classroom instruction part of the course? Should each crew be required to complete a "crew coordination" simulator session prior to the classroom instruction?**

Summary: General agreement that the pre-training evaluation mission enhances classroom effectiveness and should be included in the course.

Specific Comments:
- A simulator mission should precede the academics.
- It imparts the proper mindset for the course by showing how much a crew doesn't know or has forgotten.
- A great effect.
- Yes. This needs to be a part of the package! It was so much easier to teach the class when I could point to a crews' performance just a couple of days before.
- It brought the realism home to them because they could relate the classroom environment directly to themselves.
- Yes, it enhanced class participation.
- It helps to be able to tie teaching points in the course to mistakes on the evaluation mission.
- Yes, the simulator mission emphasizes the importance of crew coordination.
- No effect. The simulator missions after the classroom training were effective.
- A good idea. This gave the students a before and after look.
- The baseline evaluation ride facilitates classroom teaching because the instructor can refer back to it for teaching points.

Conclusion: Expanded the course to include a pre-training mission.

7. **Would read-ahead packages enhance the flow of the course? If so, what material would you suggest be included?**

Summary: Yes. General agreement on read-ahead package contents.

Specific Comments:
- I think a general synopsis read-ahead would be good. Consider including information on course origin, accident research base, history, and why the Army is going in this direction.
- Read-aheads would be good for both IPs and aviators. Could possibly reduce the amount of introductory material by synopsizing the read-ahead in the first part of the course and get going quicker.
- A read-ahead would make the first part of the course easier to teach.
- Yes, it would be good ideally, but I'm not sure a read-ahead would actually be used. Aviators will take it but probably won't use it. To be read, it must be short. Include topics like history and the program's origin, the model, objectives, elements, and the Basic Qualities to get them oriented.
- I think the crosswalk table would be helpful.
- No, read-aheads are not usually read.
- Could detract from the pre-evaluation mission.
- Include chapter 6 of the aircraft ATM, objectives, Basic Qualities, and behavioral anchors.
- Package the read-aheads like *Flightfax* and case study type articles.
- Issue after the baseline ride but before the classroom instruction.
- Include the history, model, CCO, CCE, BQ's, with very basic definitions and tie them together with a brief overview of the entire course. Would not get detailed on any one subject.
- A few pages introducing concepts and techniques.
- To be honest I don't know if the student would use them. Don't eliminate topics from the course because they are included in the read-ahead.

Conclusions:
- Included read-ahead (3-4 pages) for instructors that include case study examples and the pre-training reading assignments.
- Provided two student read-ahead packages. One is designed for use before the pre-training mission and the other is for use after the pre-training mission.

8. **Overall, did the Trainer Course adequately prepare you to teach the aviator Student Course?**

Summary: Yes. General agreement.

Specific Comments:
- Yes, especially when supplemented with knowledge gained from a broad base of operational experience.
- Inexperienced UTs need to rehearse with IPs to be completely comfortable and not too dependent on the Instructor Course materials for examples.
- I think the more you teach the course the better you get. Now that I've memorized the 13 BQs I'm a much better instructor and evaluator.
- Yes, the exception is that I needed more time to prepare the academic instruction.
- The IOs should monitor the course to understand crew coordination principles and evaluation techniques.
- Would have liked to have flown an evaluation mission. Consider substituting a baseline evaluation mission for the Trainer Course scenario familiarization mission.
- IPs and UTs should complete an evaluation mission during the Trainer Course.

Conclusions:
- Recommended that instructors need at least 2 hours of preparation time for every 1 hour of classroom instruction.
- Added a complete scenario familiarization mission to the Trainer Course with instructors performing both crewmember and evaluator duties critiqued by course trainers.
- Included all Student Course training and evaluation missions in the Trainer Course.

9. **Are there any Trainer Course segments (for example, MOI, evaluation, scenario familiarization) that should receive more or less emphasis?**

Summary: Yes. General agreement on the need for more emphasis on scenario development.

Specific Comments:
- I could have used a better overview of the evaluation scenarios and how they were developed. Consider giving us the OPORD and the evaluator worksheet as a reading assignment prior to classroom discussion.
- It would be good to have a couple of standard missions in the instructor's package. We could use them as examples to construct our training scenarios.
- Need to emphasize the scenario development section.

- Need more time for planning at the simulator facility to develop scenarios to support training and evaluation missions.
- More time could have been spent on evaluation principles. Need improved examples for the instructors to grade during classroom exercises for proficiency when the grading counts. [See related comments at item IV, 8.]
- Continue to emphasize the course objectives and supporting statistics during the first hour of instruction.
- Consider strengthening the MOI refresher segment and adding an instructor presentation and critique period.

Conclusions:
- Introduced evaluation and scenario development activities in the Trainer Course to include scenario development lessons learned.
- Identified candidate video segments from testbed crews to replace the Evaluator Workshop audio-only examples for practice ratings. Included narratives from the identified video segments in the Trainer Course.
- Strengthened the MOI refresher segment.

II. Scenarios Used During the Evaluation Phase

1. Were the evaluation scenarios of about the correct level of difficulty?

Summary: Yes. General agreement.

Specific Comments:
- Yes. Scenarios were well thought out, well developed, and just the right degree of difficulty.
- Yes. They covered most of the aspects of what we do. However, we need to tailor some scenarios for NVD. Crew Coordination is much more important in a more stressful environment. We have to train in the hardest mode which is NVD.
- Consider a third "walk" training ride with NVD. Suggest a day-NVD-day mission progression.
- Yes, at first they were a little difficult but after training the crews had little or no trouble with them.
- Scenarios could have been a little bit more difficult--more "hard location times" and complex routes.

Conclusion: Modified the Student Course to allow for local consideration of a fourth training mission with options for NVD, aircraft instead of simulator, and/or mixing crewmembers.

2. Was the scenario reasonably realistic in terms of the types of missions these aviators must execute?

Summary: Yes. Strong agreement.

Specific Comments:
- Yes. Each aviation unit will need guidance on how to develop scenarios.
- IPs should add realism by supplementing scripted events and providing communications to remind crews that they are part of a multi-ship mission. This includes navigation assistance and other unit SOP actions.
- Need to include nonrated crew members in the training, especially for the actual aircraft flight.
- See related comments at item II, 7.

Conclusion: Emphasized the importance of the scenario development guidelines section in the Instructor Course.

3. Was there enough pre-mission planning time for the crews?

Summary: Yes. General agreement that as training progressed crews went from being pressed for time to having more than enough time for pre-mission planning to include mental rehearsal.

Specific Comments:
- [At testbed start, some instructors used planning time to read through the entire OPORD instead of briefing only the main points. This practice was corrected. See item II, 4.]
- Initially, the crews felt pressed for time. By the final evaluation mission, all crews had time to spare.
- At first, the crews did not have adequate time. However, after the third mission, they had time left over. The time is just right.
- Crew coordination instruction had a significant effect. Proficiency improved with instruction and practice.
- Going from not near enough time to time left over, crews were able to conduct pre-mission planning and rehearsal that covered everything in the ATM.
- Crews learned to do mental rehearsal once they got time-organized. This technique [rehearsals] was learned from the course.
- Too time constrained to mentally rehearse at first, better time management skills acquired during the course permitted some mental rehearsal.
- I noticed that the crews were doing mental rehearsal. Everybody improved dramatically. Some [crews] rehearsed contingencies.
- Before the training, crews usually wouldn't mentally rehearse, but after the training, I saw them conduct mental rehearsals. Most crews were talking about "what if" regarding the threat, the corridors, etc.

Conclusions:
- Retained one and one-half hours for pre-mission planning and rehearsal in simulator and aircraft crew coordination training missions.
- Emphasized the importance of mental rehearsal, before flight and in the cockpit, in the course of instruction.

4. Do you have any suggestions for improving the preflight air mission briefing and crew mission briefings?

Summary: General agreement on presenting the mission briefing as efficiently as possible to preserve planning time for the crew.

Specific Comments:
- Make sure that the instructors *brief* the mission and not cut into the crew's available planning time by reading the entire OPORD. The crews can read their copy of the OPORD for coordinates, frequencies, etc.
- I think that the instructor's briefing should be an overview with highlights of the most important parts of the mission.
- Instructors should act as an operations officer during the planning.
- Consider briefing by the flow of mission segments (e.g., ingress, egress) versus air mission briefing format (e.g., 5 paragraph field order).
- Consider evaluating the crew's ability to derive the appropriate mission essential information from the OPORD.
- The most important thing during the briefing is to get the correct and the right amount of information to the crews as quickly as possible. I think we accomplished that.
- Emphasize the 1/3 : 2/3 planning rule to ensure that crews have at least 2/3 of the total time available for planning.
- Consider retaining the capability to videotape crew mission planning in the course.
- Crew briefing should use the ATM checklist.

Conclusion: Emphasized that instructors role play the Operations Officer during pre-mission planning and rehearsal.

5. Do you have any suggestions for improving the post-flight crew-level after-action review?

Summary: Strong agreement on the need to develop an AAR [after-action review] checklist for the course and an AAR task for all ATMs.

Specific Comments:
- Crews didn't fully understand crew-level AAR content. Their AARs tended to focus exclusively on technical aspects of the mission with little or no mention of crew coordination interactions except during videotape review of their flight.
- AAR became natural over time and all crews generally improved, but we have to change their mindset.
- Need a sample AAR checklist included in the course to orient discussions on crew coordination issues.
- Emphasize the goals and objectives of AAR (e.g., identify problems, causes, and solutions for mission improvement) along with instruction on how to conduct an AAR.

- Develop an AAR checklist that can be used on the aviator's kneeboard.
- Need an AAR task for all aircraft ATMs that addresses the entire mission from pre-mission planning through AAR.

Conclusions:
- Developed and included an AAR checklist and discussion on its use in the course of instruction.
- Recommended development of a Crew-Level After-Action Review Task to be included in each aircraft ATM.

6. **Do you have any suggestions for improving the post-flight evaluator debriefing?**

Summary: Strong agreement on the suggested format and benefit of videotape review as an evaluator debriefing technique.

Specific Comments:
- Videotape review is a great technique! Crews really were interested in reviewing their performance.
- It's important to have the tapes available for the evaluator's personal review.
- Used the evaluator worksheets as reminders and cues to videotape events.
- No improvements needed. Everything was available, such as tapes--which was the big thing.
- It was a challenge to separate the evaluation of the technical aspects of the mission and the crew coordination aspects. I tried to address both but individual evaluator style and technique will be an influence until the new ATM tasks are fully understood.
- Videotape capability is a must-have for this course to succeed.

Conclusion: Retained the evaluator debriefing format and emphasized the use of videotape review.

7. **What general comments did the aircrews make that might help us improve the scenario?**

Summary: General agreement on improvements to overcome the "simulator mindset" that hinders execution of realistic tactical scenarios.

Specific Comments:
- The biggest thing is the "mindset" that aviators have when using the simulator. It takes a while for the crews to feel that it's realistic.

- Multiple-aircraft operations in the simulator are difficult. It's too "quiet" in the simulator; the aircraft to aircraft interaction was not present. Aboard the single ship, the workload was distributed realistically.
- Include more scripted items on interaction with other aircraft (e.g., communication checks, other aircraft status, navigation assistance).
- Consider allowing the IO to represent other aircraft input (e.g., navigation).
- Crews enjoyed the tactical missions.
- Navigation corridors were not too restrictive.
- Make available all unit SOP mission planning materials (e.g., kneeboard size air mission briefing cards) to summarize scenario segments and events. [Provided once the need was recognized.]
- Crews suggested using laminated maps for direct posting of scenario information. Map covers in the simulator facility flight kits allowed maps to shift underneath the mission planning markup causing errors in scenario execution (e.g., routes, check points, PZs and LZs).

Conclusions:
- Expanded the course to include a third training mission in the simulator or aircraft.
- Emphasized the importance of the scenario development guidelines section in the Trainer Course.

8. **Do you have any specific suggestions for improving the scenario and/or the mission objectives?**

Summary: Yes. General agreement on including NVD conditions.

Specific Comments:
- We need to conduct this type of training under NVGs! There's a drastic difference between day and NVGs [NVD conditions].
- The NVD environment would in itself reinforce the concept of proper pre-mission planning and crew coordination throughout the mission.
- Make one of the three training missions "with NVG".
- Include more precise mission requirements like very specific locations and timing for extraction or SAR (search and rescue).
- With the equipment we have available now, the scenarios covered all mission profiles of our unit mission. Some change to the missions would have to be made for unique missions (e.g., medevac, electronic helicopter).

Conclusion: Modified the course to allow for local consideration of a fourth training mission with options for NVD, aircraft instead of simulator, and/or mixing crewmembers.

9. **Do you have any specific suggestions for improving the scenario by adding or deleting tasks?**

Summary: Yes. General agreement on substituting manual tasks for system based tasks when system capabilities and procedures are in transition (e.g., electronic aided navigation).

Specific Comments:
- Remove the task "electronic aided navigation" unless the equipment and procedures in the simulator are the same as in the aircraft. Unit aircraft have doppler--the simulator has GPS.
- New aviators coming out of flight school use GPS not doppler--aviators in the units use doppler and they don't know how to use GPS.
- Consider adding "dead reckoning navigation" and "FM homing" tasks.
- The scenario covers the tasks very well. I've discovered that some crews are having problems with the most basic tasks (e.g., fuel check).
- Emphasize that not every task is evaluated in every mission segment.

Conclusion: Emphasized the importance of task selection in the scenario development guidelines section of the Trainer Course.

10. **Did the scenarios allow adequate demonstration and observation of the 13 Basic Qualities associated with crew coordination?**

Summary: Yes. Strong agreement.

Specific Comments:
- Yes, they are all interconnected, and the scenarios gave us an opportunity to rate all of the BQs.
- I thought it [demonstration of Basic Qualities] was very good. All 13 [Basic Qualities] were there. No problems.
- All [Basic Qualities] are covered in the scenarios.
- Expect that almost any mission would accommodate all of the Basic Qualities.

Conclusion: No change to scenario development guidelines. Crew coordination Basic Qualities will be demonstrated in any well developed mission scenario.

11. If the answer to item 10 above is no, what tasks or mission events should be added to permit adequate demonstration and observation of each Basic Quality?

Summary: Does not apply.

III. Evaluator's Workbook

1. How did you utilize the Evaluator's Workbook?

Summary: General agreement on the effectiveness of the Workbook and its applicability to all phases of a mission. See comments and conclusions for items a through d.

a. During pre-mission activities?

Specific Comments:
- I really liked this book. I referred to the schedule several times at first to help establish my own schedule.
- I used the OPORD and air mission briefing to brief the crews and answer questions on the mission.
- Used the evaluator worksheets and rating guide to rate the crews during pre-mission planning.
- Reviewed ratings for the 13 BQ's to determine performance.
- I referred several times to the rating factors but mainly to the behavioral anchors to determine ratings and grades.
- I used the worksheets extensively and filled in notes as things went along.

Conclusion: Recommended use of similar scenario materials, rating guides, and worksheet organization to support evaluation of pre-mission planning in continuation training.

b. During the flight?

Specific Comments:
- I really used the worksheets a lot. They helped keep track of the mission and maintain the flow of the evaluation in the simulator. The ones we received for the testbed evaluations were so good and useful that we even created our own [based on the testbed version] for the training missions.
- I used the worksheets systematically to rate all of the BQs task by task and segment by segment.
- With the worksheet, I really l didn't have to use the videotape very much. The worksheets were one of the best evaluation techniques.
- I used the BQ references at the bottom of the evaluator worksheets to relate what I observed during the mission to the rating guide.
- The rating guide evaluation factors helped confirm the correct behavioral anchors for final grading.

- The notes block was helpful for posting notes in real time.
- Consider a kneeboard size version of the evaluator worksheet for use in the aircraft. Keep the full page version for use in the simulator.

Conclusion: Recommended use of the worksheet format and rating guides for continuation training evaluations in the simulator and aircraft.

c. During post-mission activities?

Specific Comments:
- I used the behavioral anchors along with the ATM to help crews self evaluate.
- Used the worksheets to make notes and highlight good and bad points of the crew's performance.
- The worksheets proved to be an ideal way to review the flight with the crews from start to finish.
- I reviewed my worksheet notes to debrief the crews.
- [Some evaluators used just the videotapes for mission review and crew debriefings].

Conclusion: Recommended that worksheets for continuation training evaluations include space for note taking to support crew debriefings and grade slip comments.

d. After the mission was completed (grading and rating)?

Specific Comments:
- I used the worksheet extensively.
- Used the rating guide to help complete the grade slips.
- Reviewed the behavioral anchors to determine final grades because more time was available and the behavioral anchors had more information upon which to base a grade.
- Used the guidance provided by the behavioral anchors not the rating factors in the rating guide.

Conclusion: Recommended that the grading and rating methods and materials used in the testbed be modified for use in continuation training evaluations.

2. Regarding the videotapes?

Summary: Strong agreement that crew coordination training absolutely requires videotape capability. Videotaping is essential to demonstrate teaching points and provide feedback to crews. Audio only is not acceptable. See comments and conclusions for items a through d.

a. Did you review then evaluate, or did you review and evaluate at the same time?

Specific Comments:
- I used the evaluator worksheets during the mission and posted final grades and ratings after reviewing the videotapes.
- The review and evaluate sequence was situationally dependent.
- I did not follow one specific procedure. In some cases, it was better to just let the crews see what they did on their own. In other cases the crews generally knew their strengths and weaknesses.
- The technique used depended on the crew. For a quiet crew, I would review the videotape and then evaluate.
- If my worksheet notes weren't specific enough, I evaluated and then reviewed the videotape. I didn't use the videotapes exclusively because the worksheet notes were working well.
- If my worksheet notes were not clear, then the crew and I would find the specific point on the tape and review and evaluate at the same time.

Conclusion: Recommended the use of both videotape and evaluator worksheets for continuation training evaluations.

b. Did you use the videotapes to review specific areas of the tape where you thought you missed important information?

Specific Comments:
- Yes. Used simulator mission time to annotate worksheet as a cue to where to look on the tape if I had a question and/or thought that I had missed something.
- The testbed data collection "logger sheet" was helpful to locate events on the tape.
- I used the videotapes to check problem areas or areas of uncertainty.
- Major benefit is to clear up disagreements.
- Review wasn't always necessary if I recorded everything on the evaluation worksheets.

Conclusion: Provided additional guidance on the use of videotapes to debrief crews.

c. Did you review the whole tape?

Specific Comments:
- No. Too time consuming.
- Never the entire videotape; either with the crew or alone.

- Just segments based on evaluator worksheet notes and selected portions to debrief the crew.
- Reviewed some entire segments to grade tasks like, conduct fuel check.

Conclusion: Provided additional guidance on the use of videotapes to debrief crews.

d. What general comments did the aircrews make as they observed their videotape?

Specific Comments:
- Videotaping is an excellent training aid that we should have all of the time.
- They were able to critique themselves and found it very helpful.
  - "I can't believe I did that!"
  - Recognized poor use of time.
  - Supported self-AAR.
  - Noticed errors like rally terms versus directional headings in degrees.
- One crew wanted to review their whole tape and several crews asked if they could keep the tapes after the training rides.
- Didn't understand how they interacted until they saw themselves on tape.
  - "I didn't realize I did that".
  - "I don't remember doing that".
- Emergency procedures were viewed with interest.
- For some, videotaping was kind of an ego bust. Some realized that they were more strict or authoritarian than they had thought.
- The crews could definitely see a difference in themselves as the training progressed from start to finish.
- They could actually see their mistakes as someone else would see them.
- We need to have the ability to videotape the missions so that evaluators and crews alike can review and learn from their performance as this program is implemented in the units.
- No crewmembers felt intimidated by the video cameras. They quickly forgot that the cameras were even there.

Conclusion: Recommended that all simulators and designated aircraft be equipped with video cameras to support crew coordination training.

3. **What elements of the Evaluator Worksheets were helpful or not helpful, and why?**

Summary: General agreement that all worksheet elements were helpful in minimizing the amount of time that evaluators spent recording their observations of crew performance.

Specific Comments: I used the entire worksheet. It was all useful and helpful. See additional comments at items a through f.

Conclusion: Emphasized the role of evaluator worksheets and their use in evaluator workshops. Recommended evaluator worksheets for initial and/or refresher and continuation training evaluations.

a. Segment description?

Specific Comments:
- Allowed us [IPs] to concentrate on the mission not IO duties.
- [IPs and UTs included segment description information in their own worksheets developed to support training scenarios.]

b. ATM Task?

Specific Comments:
- Provided a good indexing as crews progressed through the mission.
- Followed the sequence of scenario activities.
- Provided the ATM task number and title.

c. ATM Task performance?

Specific Comments:
- Very handy to be able to mark observations quickly.
- I could initially make a grade then review it later using the behavioral anchors for a final grade.
- It helped me grade items that I might otherwise not remember.

d. Segment overall performance?

Specific Comments:
- Segment performance criteria was too single-task specific.
- It helped me determine overall ratings and grades.

e. Aircrew Coordination Basic Qualities?

Specific Comments:
- It was especially good to have the short titles at the bottom of the page for reference.
- Consider including blank spaces for up to three Basic Quality entries per task.

f. Evaluator's Notes?

Specific Comments:
- Plenty of space for notes was extremely helpful and used routinely.
- Handy to record initial impressions of crew performance, actions, and related circumstances such as simulator malfunctions, etc.

4. Were there elements in the Workbook that were confusing? If so, which?

Summary: Mixed opinion.

Specific Comments:
- No, I found it all straightforward and easy to understand.
- I may have been inconsistent when I transitioned from the worksheet to the grade slip to grade the overall flight. I considered the grade for the whole mission to be different from the sum of the mission segments.
- The terms "behavioral anchors" and "behavioral factors" were confusing.
- See related comments at item IV, 7.

Conclusions:
- Emphasized the "whole mission" context for grading the overall flight on the Crew Evaluation/Training Grade Slip (DA Form 7172-R).
- Clarified the difference and use of effectiveness (rating) factors and behavioral anchors in the Trainer Course.

5. Are there some elements in the Workbook that you could do without? If so, which?

Summary: Mixed opinion.

Specific Comments:
- No, I liked it the way it is and used it thoroughly.
- Remove the effectiveness (rating) factors or place them behind the behavioral anchors.

- Remove the Unit SOP material.
- Generally, I only used the evaluator worksheets and the debriefing guide.

Conclusion: Recommended secondary placement of the effectiveness (rating) factors and deletion of unit SOP materials from the continuation training evaluation materials.

6. **Are there any additional elements that you would like to add?**

Summary: Mixed opinion.

Specific Comments:
- No. A great concept that was of help to me in evaluating the crews.
- Add an IO worksheet for the scenarios.
- Add the after-action review as a segment on the worksheets.
- Add an index page of the full titles for the Basic Qualities.
- Add a crew mission brief and AAR form (DA Form 5484-R).
- Add a kneeboard size mission outline or mission graphic for reference during the mission.
- Consider adding the "Suggested Points to Structure Debriefing Questions" from the Trainer Course materials.

Conclusion: Recommended including selected additions to the materials for continuation training evaluations.

7. **Do you have any other suggestions for improving the Workbook (be specific)?**

Summary: General agreement on the need for an evaluator worksheet suitable for use in the aircraft.

Specific Comments:
- Consider an abbreviated form of the worksheet reducible to kneeboard size.
- Include an IO scenario script.
- Consider including a strip map of mission segments.
- Consider moving the Basic Quality *titles* toward the front of the workbook.
- Provide evaluator worksheets to UTs for use in initial and/or refresher training missions.

Conclusions:

- Recommended evaluator worksheets for initial and/or refresher and continuation training evaluations.
- Included an abbreviated evaluator worksheet format reducible to grade slip size for use on aviator knee boards in the Exportable Evaluation Package for crew coordination continuation training.

IV. Aircrew Coordination Basic Qualities

1. Can any of the 13 Basic Qualities be combined or eliminated?

Summary: At first IPs thought that some of the Basic Qualities could be combined, but changed their minds after working with them.

Specific Comments:

- [Some IPs suggested that Basic Qualities 6 (Statements and directives clear, timely, relevant, complete, and verified) and 8 (Decisions and actions communicated and acknowledged) could be combined, but others disagreed.]
- I think that Basic Qualities 6 and 8 are two different things. If you look at the acceptable ratings on the two you can see the difference. One is communicating a decision and telling the crew what the decision is and (time allowed) why the decision was made. The other is the crew as a whole discussing the situation and the best or different course of action.
- There is apparent overlap among several Basic Qualities from an evaluator's perspective. I've given this a lot of thought. But frankly, I think they should all remain. For instance, I thought information sought and information offered could be combined, but after actually using them, I don't think it's a good idea to do any combining. They should all remain.
- No, I used them with a crew outside the project. I'm convinced that they all represent different qualities of crew coordination and are all different.
- It was difficult to apply Basic Quality 3, Selection of appropriate decision making techniques. It requires probing during the after-action review since you can't look into the crew member's mind during the mission. Need to emphasize use of the AAR to evaluate this Basic Quality.
- I'm not sure that decision making techniques can be a Basic Quality. This is a personal technique that is accomplished instinctively, and I'm not sure that it can be taught. However, I still think it should be discussed in the classroom.

Conclusions:

- Reviewed Basic Qualities 6 (Statements and directives clear, timely, relevant, complete, and verified) and 8 (Decisions and actions communicated and acknowledged) to ensure that they were sufficiently distinct from one another.
- Revised the short title for Basic Quality 6 from (Pos Comm) to (Info Xfer) to help clearly distinguish it from Basic Quality 8 (Comm Ack).

- Retained the full set of thirteen crew coordination Basic Qualities.

a. If two or more qualities are proposed for combining, give specific examples of how they overlap. [Remember: Basic Qualities do not have to be completely different from one another.]

Specific Comments:
- Consider combining Basic Qualities 6 (Statements and directives clear, timely, relevant, complete, and verified) and 8 (Decisions and actions communicated and acknowledged).
- See additional comments at item 1 above.

Conclusion: Differentiated the short titles for Basic Qualities 6 and 8.

b. If a Basic Quality is proposed for elimination, give specific reasons why this should not be evaluated as part of crew coordination performance. Also state where this aspect of performance would be evaluated, if not under crew coordination.

Summary: Evaluators identified Basic Quality 3 (Selection of appropriate decision making techniques) as a candidate for elimination.

Specific Comments:
- The decision technique Basic Quality was difficult for me. In most instances, on the ground decision making is analytical, and in the air decisions are made automatically.
- It's a good academic part, but it's not a BQ. All of the crews did this pretty well. It's a matter of survival in this job.
- Decision making is hard to see and evaluate. The technique I used was to focus on the end result. I basically rated the decision results but I asked the crews why they decided things and how they came to a decision.

Conclusion: Reviewed Basic Quality 3 (Selection of appropriate decision making techniques) and retained it as a separate crew coordination Basic Quality.

2. **How were the behavioral anchors (text descriptions) useful or not useful to you in achieving reliable and objective ratings of crew performance? Please provide specific examples, if possible.**

Summary: General agreement in usefulness of behavioral anchors.

Specific Comments:
- I used the behavioral anchors more than I used anything else. I considered all three performance levels to arrive at a rating.
- At one point I caught myself comparing one crew's performance to the performance of another crew, and I had to stop that. I went back to the anchors and reviewed them again. That helped.
- Absolute must. Couldn't have evaluated without them.
- I was concerned that evaluations would be too subjective, but the anchors helped a lot and gave me confidence.
- Very helpful in establishing a baseline and then adjusting to a final rating.
- The anchors gave me illustrations and examples that helped me establish a method for grading. For example, pre-mission planning and rehearsal and crew climate.
- Useful in communicating what is acceptable behavior and comparing poor versus good performance.
- Reviewed behavioral anchors to determine final grades because more time was available and behavioral anchors had more information upon which to base a grade.
- The hard part is tying the BQs to the task specific behavior in the ATMs.

Conclusion: Retained behavioral anchors as the principal criteria for evaluating crew coordination performance.

3. **Were some of the behavioral anchors more useful than others? If so, which ones were found to be more useful? Which ones were found to be less useful? Please provide specific examples of how you attempted to use the behavioral anchors.**

Summary: General agreement that all of the behavioral anchors were equally useful.

Specific Comments:
- I believe that I used them all--some more than others, depending on differences in each crew's performance.
- No. All were very useful in comparing a crew's performance against a written standard instead of against the performance of another crew.
- All were useful to establish a baseline for comparing crew performance.

- Pre-mission planning and rehearsal and after-action review behavioral anchors were especially helpful.
- The approach I generally used was to develop a sense for which Basic Quality or qualities applied; develop a sense for the closest behavioral anchor (e.g., 7, 4 or 1); then read the closest anchor description to select the anchor or interpolate to determine the rating.
- Helped separate Basic Qualities initially.
- I developed a tendency to use a small set but not the same set of behavioral anchors routinely.

Conclusions: Emphasized the use of all behavioral anchors in the Trainer Course evaluation workshop exercises.

4. **How were the behavioral evaluation factors (bulletized descriptions) useful or not useful to you in achieving reliable and objective ratings of crew performance? Please provide specific examples, if possible.**

Summary: Mixed opinion.

Specific Comments:
- They were good but I used the behavioral anchors. The problem with the bulletized descriptions was that one word changed the factor from a Superior to Very Poor.
- The rating factors alone weren't enough. The bulletized descriptions seemed too subjective and didn't capture what was going on well.
- Not used due to the fragmented nature of the descriptions.
- Presentation in class over-emphasized the rating factors. Should have spent more time on behavioral anchors.
- Consider using a structured method like the factors averaging technique to determine the overall mission grade (S+, S, S-, or U).
- Useful. The rating factors gave me a practical comparison for Basic Quality evaluations.
- Gave me a start that was easy to interpret and explain to the crews.
- Used throughout the missions as an abbreviated form of the behavioral anchors. For example, Crew Preparation and Composure and Resource Management factors for Basic Quality 5 (Management of unexpected events).

Conclusion: Retained the behavioral evaluation (rating) factors as a screening technique for identifying the appropriate Basic Qualities and behavioral anchors to evaluate crew coordination performance.

5. **Were some of the behavioral rating factors more useful than others? If so, which ones were found to be more useful? Which ones were found to be less useful? Please provide specific examples of how you attempted to use the behavioral rating factors.**

Summary: Mixed opinion.

Specific Comments:
- I believe at one time or another they were all very important. They gave me a start point to determine an evaluation rating.
- I don't think that there were any rating factors that were more useful than any others.
- Task prioritization and awareness level of crew were the two most useful rating factors.
- Factors were good for initial use in the simulator until I was fully familiar with the behavioral anchors.
- I used the rating factors to observe the crew's actions and relate them to the Basic Qualities; then I referred to the behavioral anchors to determine the final grades.

Conclusion: Emphasized the use of rating factors as a screening technique to apply behavioral anchors in the Trainer Course evaluation workshop exercises.

6. **How did you use the evaluation factors? Did you use them to instruct in the classroom or simulator? Crew debriefing?**

Summary: General agreement on having used the evaluation (rating) factors for classroom instruction with some references made during crew debriefings.

Specific Comments:
- The evaluation (rating) factors were very good to use as classroom instruction material. They were presented in formal training aids to link instructional topics to the Basic Qualities.
- Instructing in the course. Taught as "effectiveness factors".
- I used them occasionally to structure the crew debriefing and referenced them when discussing the mission with the crews.
- Suggest that some of the rating factors could be used to develop an After Action Review checklist.
- I used the Basic Quality definitions in the simulator and crew debriefing.

Conclusion: Retained evaluation (rating) factors in the classroom instruction as abbreviated forms of superior, acceptable, and very poor behavioral anchor descriptions.

7. **Should we continue to have both the (rating) factors and (behavioral) anchors for the evaluation guidance? If we use only one, which one would you choose?**

Summary: General agreement on behavioral anchors as the criteria for evaluating crew coordination performance.

Specific Comments:
- I was confused by the fact that there were two evaluation methods; specifically, the rating factors and the behavioral anchors. I wasn't sure at first and used both.
- The rating factors were very specific and the anchors gave general guidelines. I liked the behavioral anchors and think they are appropriate.
- I stopped using the rating factors and used only the behavioral anchors. I think the behavioral anchors allowed me to give fairer ratings.
- I used both, but if I had to choose, I would choose the behavioral anchors. I thought they were more practical in evaluating crew performance.
- More comfortable with the paragraph format (behavioral anchors) versus the bullets (rating factors). There is a danger of focusing on an isolated fact or word in the bulletized format.
- Perhaps it would be good to have them both and let the more experienced raters use only the behavioral anchors.
- Use only the behavioral anchors. The rating factors are only needed in the classroom instruction
- If forced to select only one method--keep the behavioral anchors because with experience they provide more information.
- These evaluations have a subjective part to them. The evaluation factors are too restrictive, a black and white decision. The rating factors didn't work for me.

Conclusion: Emphasized behavioral rating anchors as the principal criteria for evaluating crew coordination performance.

8. **Do the audio segments [used in the Instructor Course evaluation workshop] provide adequate opportunity for practicing your application of the rating scales?**

Summary: Mixed opinion.

Specific Comments:
- I think it would be better to use only text descriptions because we all have stereotypes in mind that effect our ratings when it comes to videotapes.
- The script was good to use with the audio tapes.
- Yes, but it would have been better to have more examples.

- Yes, they were better than written examples but video examples would be best.
- Entertaining, but unable to grade performance without seeing crew actions.
- Once I got into the behavioral anchors, then I really understood how to evaluate.
- No, applying the rating scales only became clear once we got in the simulator.
- Need video segments for effective practice exercises.

Conclusions:
- Identified candidate video segments from the crew coordination testbed missions for use in the Trainer Course evaluator workshop exercises.
- Included narrative scripts from the candidate video segments in the evaluator workshop exercises.
- Included an evaluator practice session in the simulator as part of the Trainer Course.

a. Were the 13 Basic Qualities addressed in an adequate fashion? If not, how could the segments be expanded to address each Basic Quality?

Summary: Mixed opinion.

Specific Comments:
- Yes, I think that there was enough on each segment. However, if it's possible to add more video examples to explain how to evaluate the BQ's, they should be added.
- Not really, need more segments or longer segments.
- Basic Qualities were covered very well.

Conclusion: Identified candidate video segments from the crew coordination testbed missions for use in the Trainer Course evaluator workshop exercises.

b. Would you find *video*tapes to be more useful? If so, what type of vignettes would you recommend be included?

Summary: General agreement that videotapes would be superior to audio tapes.

Specific Comments:
- Use a video segment to walk through the entire evaluation process, step-by-step.
- Yes, I would like to have videotapes for the evaluation exercises. Suggest adding contrasting excerpts from the before and after training flights of selected testbed crews.
- Suggest a "branching" video that includes both good and bad crew performance in a series of related situations.
- More video segments of accidents or incidents.

- Consider developing videos that show an event with flashbacks to premission planning or other crew coordination activities that would have assisted in resolving the situation.
- Video would be fine but audio provides the same points. Audience concentrates more on performance when audio is the primary media.
- Consider developing a videotape that has two female-rated aviators and see how the crew is rated by male and female evaluators.

Conclusions:
- Identified candidate video segments from the crew coordination testbed missions for use in the Trainer Course evaluator workshop exercises.
- Included narrative scripts from the candidate video segments in the evaluator workshop exercises.
- Identified candidate video segments for possible use in developing a "branching" videotape for training and/or evaluation exercises.

9. **Was the 7-point scale a good choice for rating crew coordination Basic Qualities? Were the descriptors (very poor, poor, marginal, adequate, acceptable, good, very good, superior) for each number helpful? Do you have any suggestions for improvement?**

Summary: Strong agreement that the scale and anchor descriptions provide the basis for objective, reliable ratings.

Specific Comments:
- Excellent. Don't change a thing.
- There is enough difference between 7, 4, and 1 to decide where to interpolate.
- Had some initial problems interpreting between 1 to 4 and 4 to 7 but with practice, it was OK.
- The scale range is good.
- Consider providing the crews with the behavioral anchor descriptions not just the abbreviated rating factors.
- See related comments at item IV, 10a.

Conclusions:
- Retained the 7-point rating scale and behavioral anchor descriptions for evaluating initial, refresher, and continuation crew coordination training.
- Included the behavioral anchor scale and descriptions in the Student Course materials.

10. **Think back to each of the 13 Basic Qualities. Each has a *behavioral anchor* for numbers 1, 4, and 7.**

    a. Were the behavioral anchors helpful?

    Summary: Yes. Strong agreement.

    Specific Comments:
    - Yes. See related comments at item 9.
    - They gave me the descriptions and examples I needed to rate crew coordination skills.
    - Too much information to use in the cockpit but great for determining final grades.
    - Best source to evaluate pre-mission planning and rehearsal and after action review activities.
    - See related comments at items 2 and 3.

    Conclusion: Retained behavioral anchor descriptions with minor changes.

    b. What are your suggestions for improving them (be as specific as possible so we can incorporate your suggestions)?

    Summary: General agreement that few if any changes are needed.

    Specific Comments:
    - Consider adding checklists (e.g., hover power check, landing check, etc).
    - I would have liked to use a plus or minus in conjunction with the scale rating (e.g., 3+, 4-, etc). I recognize that this would create a 21 point scale but the benefit might be worth it. For example, if a crew had difficulty with an emergency procedure and didn't do the procedure correctly, or didn't do it at all, but very good crew coordination was the only thing that enabled that crew to make a safe landing, the rating for them under BQ 4; management of unexpected events might be a 3+.
    - Consider developing descriptions for intermediate ratings (i.e., 2, 3, 5, & 6).
    - I think they were very clear and easy to use. No suggestions for improvement.

    Conclusions:
    - Retained behavioral anchor descriptions with minor changes.
    - Included the use of checklists in Basic Quality 10, Crewmember actions mutually cross-monitored.

11. Think back to each of the 13 Basic Qualities. Each has *evaluation (rating) factors* for numbers 1, 4, and 7.

a. Were the evaluation (rating) factors helpful?

Summary: Mixed opinion.

Specific Comments:
- Yes, at first they were real helpful and I needed them but later I didn't use them.
- At first I used them to compare performance and derive a guideline for evaluations. However, I don't think they were as specific as the behavioral anchors. I preferred the behavioral anchors.
- Served as memory joggers and a shorthand checklist of behavioral anchors.
- No, did not use them for evaluations.
- Useful in teaching the course. Explanations are short, easy to read outlines of performance.
- See related comments at items 4, 5, and 6.

Conclusions:
- Emphasized behavioral anchors as the principal criteria for evaluating crew coordination performance.
- Retained evaluation (rating) factors for the classroom instruction.

b. What are your suggestions for improving them (be as specific as possible)?

Summary: Mixed opinion.

Specific Comments:
- Include the rating factors in the behavioral anchor descriptions.
- Change the name from rating factors to "effectiveness factors."
- No suggestions for improvement.

Conclusion: Retained in classroom instruction without modification.

12. Were you reluctant to give crews ratings below "fully acceptable"? If yes, why?

Summary: No. Strong agreement.

Specific Comments:
- No. I gave low ratings when I saw them.
- I had no hesitation to give low ratings where appropriate

- Yes, initially I was somewhat reluctant given the S or U grading mindset because a "U" means that a crew goes to RL 3 and impacts the entire unit.

Conclusion: Retained the behavioral anchor descriptions and 7-point rating scale for evaluating initial, refresher, and continuation crew coordination training.

13. **If you had experience using both the behavioral anchors and the evaluation factors, do you think that one or the other methods influenced you to give higher or lower grades? For example, if you used the evaluation factors, do you think that led you to give higher or lower grades than if you had used the behavioral anchors?**

Summary: General agreement that the behavioral anchors produce more reliable evaluations of crew coordination performance.

Specific Comments:
- Yes, there are differences. The rating factors are very specific. They either fall into a factor or not. The behavioral anchors gave me wider latitude and allowed me to compare performance in relation to the anchored standard. I could easily decide if crews were close to a description and then decide if they were a little better or worse than the behavioral anchor.
- The description of the behavioral anchors had more underlying meaning and I found them to be more effective than the rating factors.
- I moved away from using the rating factors and used the behavioral anchors instead. Had I continued to use the rating factors, I probably would have been more inclined to give fours. With the behavioral anchors I was more able to select a 3 or a 5.
- Wording of the behavioral anchors provided sufficient range.
- Rating factors and behavioral anchors seem to complement rather than conflict or contradict. No affect on grades given.
- I believe the behavioral anchors let me give a more precise evaluation because of the description and examples for each rating level.
- The rating factors led me to give a higher grade because they were not as specific as the anchors.
- N/A since didn't use the behavioral factors.
- I think the behavioral anchors would lead to lower ratings because they give a more complete picture of what evaluators see.

Conclusion: Retained the behavioral anchor descriptions and 7-point rating scale for evaluating initial, refresher, and continuation crew coordination training.

14. How often did you refer to the explanations in the behavioral anchors?

Summary: General agreement on frequent use (every evaluation) initially with continued referencing of them by experienced evaluators.

Specific Comments:
- All the time. Some Basic Qualities more than others.
- Frequently at first, then only by exception.
- Very often at first, then infrequently during last two evaluations.
- Basically everyday, if just to reinforce the description in my own mind. I did this to be sure I'd give the crew the fairest grade.
- Almost every training ride in the simulator.
- For the initial evaluations, I used all of the BQ descriptions all of the time. Then some things sunk in and I didn't have to refer to them as often.
- I reviewed them initially; looked at them again for the first ride; and then did not have to refer to them again.
- Almost always. I would refer to the rating factors first, then I would refer to the behavioral anchors unless it was clearly covered in the rating factors.

Conclusion: Emphasized behavioral rating anchors as the principal criteria for evaluating crew coordination performance.

15. How often did you refer to the evaluation (rating) factors?

Summary: General agreement on occasional use (very little) at first and then dropped during evaluations. However, they are useful for classroom instruction.

Specific Comments:
- Whenever I needed to grade a task for the first time.
- At first I used them, then I dropped them.
- Initially, I referred to both evaluation factors and behavioral anchors; but as time went by and I became more comfortable and knowledgeable I referred to the evaluation factors less and less.
- Maybe once.
- Never.
- Only in class.

Conclusion: Retained evaluation (rating) factors in the classroom instruction.

16. **Did the frequency of referral to the behavioral anchor descriptions change over time (e.g., less referral to the anchor descriptions with experience)?**

Summary: Yes. Strong agreement.

Specific Comments:
- See related comments at item 14.
- Yes, with more experience the less I referred to them.
- Yes, especially for those that I used the most.

Conclusions:
- Emphasized behavioral anchors as the principal criteria for evaluating crew coordination performance.
- Encouraged instructors to refer to the behavioral anchor descriptions frequently to avoid the habit of comparing crews to one another instead of comparing performance to the behavioral anchor description.

17. **Did the frequency of referral to the evaluation (rating) factors change over time (e.g., less referral to the factor descriptions with experience)?**

Summary: Mixed opinion.

Specific Comments:
- See related comments at item 15.
- Yes, maybe a little.
- No.
- Not applicable. Did not use rating factors other than in the classroom.

Conclusion: Retained evaluation (rating) factors in the classroom instruction.

18. **Are there any aspects of crew performance not adequately covered in the 13 Basic Qualities?**

Summary: No. General agreement on emphasizing the crew coordination aspect of after action review and including the use of checklists in existing Basic Quality descriptions.

Specific Comments:
- No, full coverage.
- The 13 adequately cover all aspects.

- Relook the wording and substance of Basic Quality 13, Crew level AARs accomplished, to consider both crew coordination actions and flight tactics and techniques for each mission segment.
- How about the use of checklists and procedures? There was nothing in here that allowed me to remark about "this is something that every aviator ought to know coming out of flight school."
- Seemed to cover everything; may get interesting when nonrated crewmembers are included in the program.

Conclusions:
- Developed and included an AAR checklist and discussion on its use in the course of instruction.
- Included the use of checklists in Basic Quality 10, Crewmember actions mutually cross-monitored.

a. If so, would you address these aspects within the context of one of the existing Basic Qualities? Please be specific.

Summary: Does not apply.

b. If so, would you address these aspects as a separate Basic Quality? Please be specific.

Summary: Does not apply.

V. Modified Grade Slips

1. Was the format of the grade slip understandable and easily used? Any specific suggestions for improvement?

Summary: Yes. Strong agreement.

Specific Comments:
- Yes, easily understandable. It's really not much different from the current grade slips.
- Easy to use. Like using the maneuver procedure grade slip.
- Yes, I thought it was easy to understand and very similar to the one we use now.
- Easy to use. It followed the already familiar maneuver procedure grade slip.
- Easy and understandable. No problems.
- Basic Qualities list at the bottom of the grade slip is sufficient for in flight reference. I referred to the full descriptions before signing the grade slip.
- Consider shading the scenario driven tasks. [This was done for the testbed pre- and post-training evaluations.]
- Consider including the Basic Qualities reference line in the ATM maneuver procedure grade slip.

Conclusion: Retained the Aircrew Coordination Training Grade Slip for evaluating initial and refresher crew coordination training.

2. Did you weight flying skills and aircrew coordination skills differently? Did you give them equal weight?

Summary: Mixed opinion.

Specific Comments:
- I tried to separate them, but sometimes they are very bound up. For instance, on approach if the pilot flying was too fast, he had to use his skills to slow. But the pilot not flying should have announced the landing earlier so the aircraft wasn't going so fast in the first place--that's the crew coordination piece.
- It varied. For the testbed, I weighed crew coordination more, but for some specific maneuvers, I weighed them about 50-50, and for other things I leaned toward the flight skill. I always considered crew coordination.

- Weighing shifted during the course. I made a conscious decision to weight crew coordination heavily later in the course, e.g.,

prepost		
flying skills	80%	20%
crew coordination	20%	80%

- Equal weight e.g., non-precision approach, flying skills on breaking altitude, crew coordination on cross monitor performance.
- For the purpose of the testbed, I weighed aircrew coordination heavier than flying skills. However, for some specific maneuvers (i.e., major malfunction, inadvertent IMC, radio navigation, nonprecision approach) I weighted flying skills just as heavy if not heavier than crew coordination.
- I concentrated mainly on crew coordination and rarely commented on flight skills.
- Yes, I weighted them differently. The course purpose was to look at crew coordination. I gave more weight to the crew coordination aspects.

Conclusion: Emphasized the Aircrew Training Manual evaluation principle that the evaluator's subjective analysis and judgment are central to reliable evaluations of crew performance.

3. **Was the satisfactory plus (S+), satisfactory (S), and satisfactory minus (S-) grading system helpful? Would you like to use S+, S, and S- for APART rides?**

Summary: Yes. Strong agreement.

Specific Comments:
- I think it was helpful, especially when using the two BQs as the basis for the grade. If we only have an S, it's not enough information.
- I would like the S- instead of the U available. It seems fairer. A crew may be weak and while I don't want to give them a U, an S is too good.
- For a teaching tool, the S+ and S- are good to show progression, but for an evaluation tool, I'm not sure.
- I thought it was very helpful during these evaluations. I would like to see it used in the field with guidelines that an S- has to be corrected within a certain amount of time. Also, if we used S+, it would allow us to track the strong aviators and maybe spread the talent.
- The S- would help me "go home at night." For example, I would like to have the option to give a S- instead of an S when it takes a crew three attempts to perform a maneuver to standard.

- Very helpful for evaluation; can give a U for a maneuver without grading the overall mission Unsatisfactory.
- Not suitable for individual APART given the current guidance.
- The expanded grading system gives IPs leeway to identify strengths and weaknesses without issuing Unsatisfactory grades.
- I would love to use this system on APART. Some aviators are satisfied to be within the limits while others strive to be exact.
- Yes, it was very helpful. I would like to see this used in the field with a guideline of options to be followed should someone receive an S-. For example, if an S- is received for an oral evaluation, that person must be reevaluated on the oral within ten days from the date of the S-. If the next evaluation is no better, then the grade automatically becomes a U.
- Being able to use an S+ would provide a way to identify and track strong performing crews.
- Yes, it is more specific and gives something the shoot for (S+).
- Recommend changing to the expanded grading system, but it would require a lot of changed thinking. Probably best to use it only for crew coordination training.

Conclusions:
- Retained the expanded grading system (S+, S, S-, U) for evaluating initial and refresher crew coordination training.
- Recommended that the USAAVNC revise the APART field grading system to allow for use of the expanded grading system (S+, S, S-, U).

4. **Would you have liked to use the Basic Quality notations (1,2, . . .13) for *both* positive and negative crew coordination behaviors? If yes, would using a "+" or "-" sign next to *each* BQ associated with ATM Task performance be a reasonable marking technique, or do you think it would be too complex?**

Summary: Mixed opinion.

Specific comments.
- Yes, I think that would be a good idea. I don't think it would be too complex. We could do that. For now I used the worksheet and the comments.
- The technique would not be too complex. It would become easier over time and could provide better information to make final grades and ratings.

- Yes, I think it's a good idea. I think it provides a better measure of crew coordination abilities. It is just as important to note positive as well as negative performance.
- Not necessary since a grade with a + or - indicates the weight and/or direction of the contributing Basic Qualities.
- No, I wrote up exceptional performance, both superior and poor, on the comment sheet.
- I think that the number ratings on the grade slip should be sufficient for evaluating Basic Qualities, both positive and negative.

Conclusion: Included an option for evaluators to use a "+" or "-" sign next to the Basic Quality numbers (for example, S +7, -10) to identify both positive and negative crew coordination contributions to task performance.

5. When you gave an overall mission grade, what were your criteria?

Summary: General agreement that criteria for overall mission grade is a synthesis of the ATM standards for the tasks performed supported by Aircrew Coordination Training Grade Slips and evaluator worksheets.

Specific Comments:
- It was a combination of everything including crew coordination, flight skills, mission success. I weighed them about equally.
- Worksheet notes to determine Basic Quality ratings (i.e. the number of + and/or - from task grades).
- Averaged Basic Quality ratings to determine overall grade (e.g., 4 = S).
- I compared the ATM crew coordination description and the standards for the maneuver with what I observed.
- Primarily, I used the worksheets as a guide.
- I mixed crew coordination and flying skills with more weight given to crew coordination.
- I used the Basic Quality ratings.
- I considered the importance of the task grades.
- Became more influenced by Basic Quality ratings rather than the ATM task grades.
- Used grades from the grade slip, comments on worksheet, and ATM.
- Considered the overall mission. A "U" on a task did not negatively affect the overall grade but was considered with everything else.

Conclusion: Retained the Aircrew Coordination Training Grade Slip and evaluator worksheets for evaluating initial and refresher crew coordination training.

6. **Did you find the Comment Slip useful? If not, do you have any specific suggestions to improve its use?**

Summary: Yes. Strong agreement.

Specific Comments:
- I used it everyday. It worked fine.
- Included general comments on the flight.
- Used it to explain S-, S+, or U grades on maneuvers.
- Captured Basic Quality contributors to task grades.
- Yes, I used it with every flight.
- Comments are always useful (for example, strengths and weaknesses).
- Yes, for annotating deficiencies or exceptional performance.
- No suggestions for improvement.

Conclusion: Retained DA Form 7121-R, Battle-Rostered Crew Evaluation Training Grade Slip for use in evaluating crew coordination initial, refresher, and continuation training.

VI. General Observations

1. What is your overall impression of the adequacy of the *aircrew coordination training* provided? Do you have any recommendations for improvement?

Summary: Strong agreement that the training provided is fully adequate to implement crew coordination training in aviation units.

Specific Comments:

- The positive response from the crews and the increase in performance speaks for itself.
- The information is being taken back to the flight line right now. IPs will use it individually between now and when the package is formally fielded.
- I think this is a good program. We should be doing it now. Good crews have been doing it without realizing it. Now it's organized and we can understand it better.
- Effective crews must practice crew coordination or they are looking for an accident.
- For this kind of training and evaluation, I thought it worked very well. I think it's really important.
- We saw so much improvement after only three days in a classroom and three sessions in a simulator cockpit. I think that speaks volumes.
- Successfully demonstrated that we can train crew coordination in units.
- Great impact on self and crews.
- IP/UT mix for team training was very effective.
- Scenario development by instructor teams was good to capture different ideas.
- Very well organized and thorough. I was impressed with the whole program. It's professionally organized and taught. I'm not sure it could be done any better.
- This stuff really works.
- Enhances everybody's ability to perform safely.
- Good. Consider adding more practical exercises. [See related comments and conclusions at items III, 3 and 12 through 15 in the Summary of Crewmember Exit Interview Results.]
- Very good. Need to get the chain of command involved from the start when a unit starts the training program. [See related comments and conclusions at item II, 6 in the Summary of Crewmember Exit Interview Results.]
- My concern is with the implementation of the TC's 1-210, 1-212 upon us, how do we go about bringing the rest of our units up to this level? It would be a shame to have all of this material available, and not use it.

- One thing I liked about the course is that it wasn't written at the 6th grade level. I think it's important to keep the significant information; don't just focus on the task details. Aviators should have both for complete understanding. We should train to the maximum; not the minimum.
- I wonder how difficult it's going to be to incorporate crew chiefs into this training. They should be in the same class, but the simulator work is not possible. We will have to involve crew chiefs aboard the aircraft. [See related comments and conclusions at item IV, 1 in the Summary of Crewmember Exit Interview Results.]

Conclusion: Revised the validation testbed course of instruction to final for use as the USAAVNC's Exportable Training Package for initial and refresher crew coordination training.

2. **What is your overall impression of the adequacy of the *evaluation training* provided? Do you have any recommendations for improvement?**

Summary: Strong agreement that the training provided is fully adequate to permit unit IPs and UTs to conduct objective, reliable evaluations of crew coordination performance.

Specific Comments:
- It's good. Initially, it seemed like a lot, but the more we practiced, the easier it became.
- I was very comfortable with my training. It was just great. I could do everything I needed to do and I could give fair grades.
- Comfortable evaluating crews.
- Evaluators should have the full set of training missions instead of only the scenario familiarization mission. [See related comments and conclusions at item I, 8.]
- About the right amount of time. [See related comments and conclusions at items I, 1 and 9.]
- Practical exercises in the evaluator workshop were good. Need to do at least 3 or 4 exercises.
- Need to emphasize the capability [to record simulator time on evaluator worksheets to locate events on videotape for review] in the Trainer Course (e.g., evaluation workshops).

Conclusions:
- Added a complete scenario familiarization mission to the Trainer Course with instructors performing both crewmember and evaluator duties critiqued by course trainers.

- Included all Student Course training and evaluation missions in the Trainer Course.
- Revised the evaluation training sections of the validation testbed course of instruction to final for use as the USAAVNC's Exportable Training Package for initial and refresher crew coordination training.

3. What is your overall impression of the conduct of the aircrew coordination evaluations? Do you have any recommendations for improvement?

Summary: Strong agreement that evaluations were objective and reliable.

Specific Comments:
- I thought the evaluations were effective. They worked well.
- My overall impression is that the evaluations were done very properly and professionally. The only caution is that evaluators should guard against imposing their personal crew coordination techniques before the crews have time to practice using the Basic Qualities for themselves.
- I think it's important to keep the crews together and keep them battle-rostered. I also think that we should not swap crews during the training. Perhaps a better idea is to split up the evaluators.
- Reliable, objective, and fair.
- Evaluating in the cockpit while on the controls as a crewmember will be a challenge
- The video segments and testbed data collection logger sheets were a great help (e.g., cleared circling, busted MDA, crew disagreements over task completion).
- At first, I didn't think there was any way to fairly evaluate crew coordination. After seeing this technique, I am convinced that it is fair and necessary.
- Evaluations covered all aspects of crew coordination and allowed me to use my own judgement as required.
- Need to provide students with behavioral anchor descriptions.

Conclusions:
- Included the behavioral anchor scale and descriptions in the Student Course materials.
- Retained the testbed evaluation methods and materials for use in the USAAVNC's Exportable Training Package for crew coordination initial and refresher training evaluations.
- Retained the testbed evaluation methods and materials for use in the USAAVNC's Exportable Evaluation Package for crew coordination continuation training evaluations.

4. **If this training package is fielded Army-wide, should there be a system to track testbed participants in longitudinal studies of the Army's crew coordination program?**

Summary: Yes. General agreement.

Specific Comments:
- Yes, I hope the crews take this material to heart and use it.
- Yes, I would appreciate being included in the studies.
- Yes, it would help identify army wide program weaknesses.
- It might be better to track a class from flight school.
- Would be interesting as participants will start applying their own techniques. This training is just the base.

Conclusion: Recommended that the class roster of testbed participant instructors and aircrews be retained to follow up crew coordination policy, program, and training progress over time.

5. **What effect has participation in this project had on you personally?**

Summary: General agreement on positive effect.

Specific Comments:
- It now gives me something to grasp so that I can put it out to the aviators.
- Regarding techniques, this course has really assisted.
- Improved my knowledge of scenario development.
- Confirmed previous views on evaluating task performance.
- Clearly defined previous beliefs about crew coordination.
- Focuses common knowledge.
- Improved my ability to communicate strengths and weaknesses during evaluations.
- Makes my evaluations more objective than subjective.
- Able to evaluate as a crew.
- Whether this program is fielded or not, it's made me a better aviator and evaluator. It's given me another tool to use to teach good positive habits in the cockpit.
- It supports a number of my personal beliefs about crew coordination.
- After attending, I am convinced it has made me a better crewmember.
- Anyone who has the desire to be a better pilot or crewmember will find this training rewarding.
- I'm already using the concepts taught in class during missions in my unit. A multiship NVG assault mission last week was the best mission I have flown (from planning - execution - AAR) in my aviation career.
- I can now help other unit aviators.

- Makes me think about how I communicate and how to be a better communicator.
- I never knew what all I was doing wrong until I attended this course.

Conclusion: Recommend that the letters of transmittal that accompany the exportable training course and the exportable evaluation package to units in the field convey the positive effect the course had on testbed participants.

6. **Do you have any questions or concerns that you would like to ask or convey to the crew coordination staff?**

Summary: Open discussion surfaced both questions and concerns.

Specific Comments:
- The plan for flight school students. Will they have the benefit of videotaping training? [Yes, funds permitting. Probably in the AQC course.]
- Are there plans to monitor IPs on the flight line? [Yes, the USAAVNC has already started with the Apache IPs.]
- I would be willing to work on exporting this package on a world-wide basis. I believe in the program.
- Extremely professional. It's apparent that a lot of effort and thought went into the course.
- Major concern is how the course will be implemented Army-wide.